The HANDBOOKS *of* OPERATIVE SURGERY

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Surgery of the

HEAD *and* NECK

A HANDBOOK OF OPERATIVE SURGERY

Surgery of the

HEAD *and* NECK

by

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DEDICATED

TO

Agnes AND *Corene*

Preface

THIS HANDBOOK is written for the general surgeon who is frequently called on to care for surgical lesions arising in the region of the head and neck. Many of the surgical specialties overlap in the operative treatment of diseases of this region and contributions to diagnosis and treatment have been made by the neurosurgeon, the plastic surgeon, the ophthalmologist, the otolaryngologist, and the dental surgeon. This handbook does not include a description of the procedures managed exclusively by these specialists. However, certain operations occurring in special fields are described because the general surgeon is often required to perform them. For example, a description is given of total laryngectomy and its combination with radical neck dissection and of various plastic procedures used in the management of tumors of the skin and lips.

The trained general surgeon with experience in head and neck surgery is ideally equipped to manage the extensive operative procedures in this field. He is familiar with technics of securing wide exposure, with recent advances in vascular surgery, and with principles of adequate tumor surgery. In addition, in his daily practice he frequently deals with complicated problems of fluid balance and nutrition and those of infection. This experience is required in the successful care of these patients.

The increasing number of traumatic lesions of the head and neck caused by automobile and other accidents has placed a heavy responsibility on the general surgeon who is usually required to treat these injuries. Chapter 5 emphasizes the importance of

prompt and thoughtful care of these wounds Included is a description of the operative treatment of extradural hemorrhage, for it is our conviction that every general surgeon should be able to treat such a condition in an emergency when a neurosurgeon is not available

We have selected from a large number of operations possible in the head and neck those procedures which we have found most safe and effective in dealing with commonly presented surgical problems Space has permitted inclusion of only a few of the modifications, extensions, and alternate measures which exist Since this is primarily a handbook of operative therapy, alternative nonsurgical methods of treatment, such as radiation therapy, receive only brief discussion Only a few references are given and a bibliography is not included in this book

Credit for the perfection and popularization of many of the operative technics for tumors of the head and neck is given to Dr Hayes Martin and his associates of the Head and Neck Department of Memorial Hospital, New York We are grateful to Miss Jessie W Phillips, director of the Medical Illustration Department, University of Washington School of Medicine, for the illustrations accompanying the text Her ability to produce a few crisp line drawings after observing a long complicated operative procedure has been essential in the preparation of this handbook Appreciation is also expressed to Marjorie Hoag Emery, our assistant artist We acknowledge the help given by Kenneth E Livingston, M D , in the preparation of the section on head injury, and the suggestions of Ernest R Nichol, D D S , and Edward J Puhaty, D D S , regarding dental anesthesia and prosthetics We are also indebted to Miss Jeri Dick and Mrs Dorothy Vickers for their work on the manuscript and to the Year Book Publishers for their fine co-operation and encouragement

ROBERT A WISE
HARVEY W BAKER

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CHAPTER 1

General Considerations

THE HEAD AND NECK can be one of the most rewarding areas in which the surgeon works Benign and congenital lesions, some causing considerable disfigurement, can be completely and permanently removed Malignant tumors, because of their tendency to remain confined to this region for a long period, can often be successfully eradicated Traumatic lesions, of such frequent occurrence today, can be treated with assurance that a minimum of late sequelae will result Inflammatory lesions can be controlled by judicious use of antibiotics and by surgical drainage when indicated

Safety in surgery of the head and neck depends on a thorough knowledge of the anatomy of the area The anatomy is remarkably constant, the fascial planes so constituted that, once learned, dissection is made certain and important structures are protected easily In few surgical fields are clean anatomic dissection, hemostasis, and exposure so important, for it is only by these measures that essential structures can be preserved

Considerable progress has been made in head and neck surgery in recent years Procedures which formerly resulted in prolonged morbidity and high mortality can now be performed successfully with little risk This improvement is due largely to the advent of the antibiotics and the development of endotracheal anesthesia Postoperative infections, many fatal formerly, have been almost completely controlled, and cervical abscess and cellulitis treated without fear of spread The assurance of general anesthesia with an adequate airway has greatly facilitated the performance of sur-

gery which formerly was considered impossible or extremely hazardous

There are a number of other factors which have brought about progress in this field More accurate methods of diagnosis have become available and have been widely applied These include newer x ray technics the use of radioisotopes and a variety of useful specific laboratory tests of the blood and plasma Advances in preoperative preparation of the patient and postoperative management have been of the utmost importance A better understanding of fluid and electrolyte requirements has aided in both preoperative and postoperative care The availability of whole blood before during and after surgery has increased the safety of extensive procedures An increased interest in rehabilitation with an aim to restore each person to as near normal appearance and function as possible following surgery has resulted in many more patients resuming active and useful roles in society

There are a number of new and important technics with which the surgeon should be familiar In the field of trauma emphasis is being placed more correctly on primary repair of facial injuries with reduction in prolonged and less satisfactory reconstructive measures The use of arterial homografts or arterial prostheses to re-establish continuity following laceration or erosion of the common or internal carotid artery may be lifesaving The availability of improved plastic prostheses to temporarily or permanently hide deformity from traumatic loss of tissue or extensive surgery has been of great help

The "combined operation" for cancers of the oral cavity hypopharynx, or larynx in which the primary lesion is removed in continuity with its direct or lymphatic extension into the neck marks a notable advance in the treatment of cancer in this region The superiority of this procedure over radiation therapy or the combination of irradiation and surgery is we believe being demonstrated

CHAPTER 2

Examination of the Head and Neck

DIAGNOSTIC PROCEDURES

A CORRECT DIAGNOSIS may be obtained more easily in many diseases of the head and neck than in most other anatomic regions The history and physical examination plus the performance of a biopsy, when indicated, often settles the diagnosis and clarifies decisions concerning therapy

A careful history is as important in the evaluation of disease in this region as it is in other fields of medicine The mode of onset and the duration of the symptoms must be determined as accurately as possible A cervical mass of short duration or one recurring at intervals may be inflammatory A lesion existing for a long period may be congenital or a benign tumor Rapidly enlarging masses are often malignant History of previous operation is important The patient presenting a submental mass, for example, may give a history of previous excision of a cancer of the lip History of trauma is of importance for medicolegal reasons It may also explain mandibular, zygomatic, or nasal deformity

History of dental treatment is often of importance in arriving at the correct diagnosis of inflammatory lesions of the neck Tender, brawny induration beneath the chin and mandible is most likely Ludwig's angina if there is a recent history of lower molar extraction Persistent sinuses around the maxilla and mandible following dental treatment point to osteomyelitis

Specific inquiry regarding difficulties in breathing talking chewing or swallowing should be made Determining the onset and duration of hoarseness is important. The presence or absence of pain must be noted. For example benign parotid tumors are seldom painful, while parotid carcinomas often cause severe pain Pain following irradiation of a malignant lesion may be due to radiation effect or recurrence Pain in the ear often indicates a lesion of the pharynx or larynx

Examination of the head and neck should be orderly and follow a definite pattern Inspection is frequently the most important part of the examination. It should include appraisal of the skin and contours of the region as well as careful visualization of the nasal and oral cavities the external auditory canal the pharynx, larynx and, in many instances the nasopharynx.

The presence of ulceration abnormal swelling, edema, or exudate is noted. Observation of deformities following trauma is important. Flattening of the infra-orbital region is seen in certain zygomatic fractures and mandibular and maxillary fractures exhibit typical deformities The presence of subconjunctival ecchymoses may lead to the diagnosis of skull fracture

Abnormal function resulting from injury to cranial nerves must not be overlooked. Tumor infiltration or traumatic division of the 7th nerve results in inability to wrinkle the forehead, close the eye, or purse the lips Loss of hypoglossal nerve function causes deviation of the tip of the tongue to the side of the lesion. Division of the vagus or recurrent laryngeal nerves paralyzes the vocal cord while injury to the spinal accessory nerve results in inability to shrug the shoulder

Palpation will aid greatly in the evaluation of head and neck lesions By palpation, a cervical mass may be discovered which was overlooked by inspection The consistency of the mass should be noted. Is it hard, rubbery or fluctuant? Mobility or fixation to surrounding tissue is important. The location of the mass may be suggestive Supraclavicular masses frequently represent metastasis from a primary lesion below the clavicle such as cancer of the intestinal tract, pancreas and lung, or from cancer of the thyroid gland. Masses in the upper cervical region, on the other hand, are far more often related to a primary cancer of the head and neck

1] *Palpation*

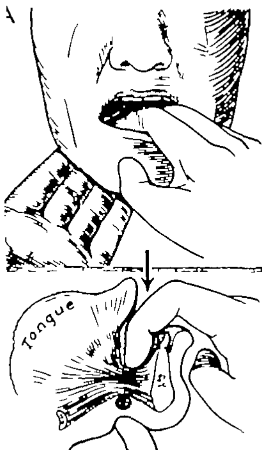
A —The value of palpation within the mouth is frequently overlooked Introduction of a gloved finger into the oral cavity allows more accurate estimation of the size of a visible lesion as well as determination of its consistency, its tenderness, and its fixation to neighboring structures The submaxillary triangle of the neck can be most adequately examined by bimanual palpation with one finger on the floor of the mouth and the opposite hand beneath the mandible The submaxillary salivary gland is then readily outlined, and enlarged lymph nodes within or around it are palpated easily

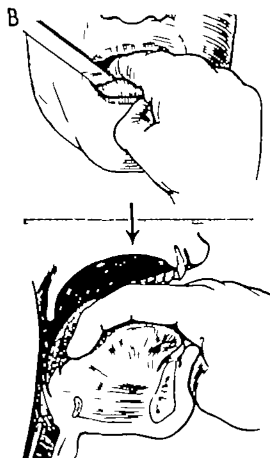
B —A gloved finger swept quickly across the base of the tongue and up behind the soft palate may detect a hidden tumor mass missed on the usual routine inspection of the oral cavity with tongue blade

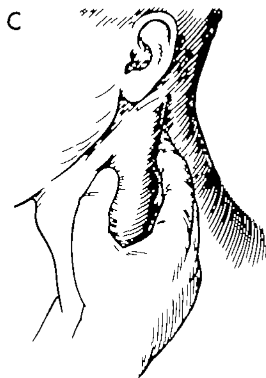
C —Each side of the neck should be palpated methodically so that no cervical masses will be overlooked The patient's head is tilted gently from one side to the other so that the sternocleidomastoid muscle may relax, allowing the thumb and fingers of the examining hand to encircle it and palpate the jugular chain of lymph nodes The posterior triangle of each side of the neck is palpated by moving the examining fingers over the region in a horizontal direction to detect small and often deeply located nodes The external surfaces of the larynx are palpated to detect tenderness or deformity A normal larynx may be moved from side to side in the neck with a palpable crackle of the cartilages Infiltration of the larynx by tumor or inflammatory reaction will cause fixation and loss of the usual crackle In disease of the larynx, the prelaryngeal node lying on the cricothyroid membrane may be palpated occasionally

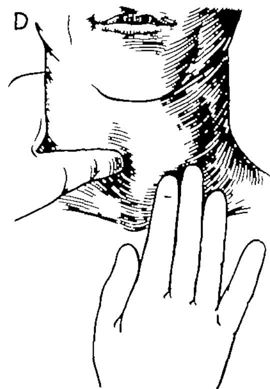
D —The thyroid gland is best examined by pushing the larynx and trachea to one side with the thumb The other hand is then used to palpate the lobe of the thyroid made more prominent by this maneuver As the patient swallows, the lower pole of the lobe will rise and the fingers pass beneath it Failure to palpate the lower pole should suggest substernal extension of the thyroid

PLATE 1









Palpation

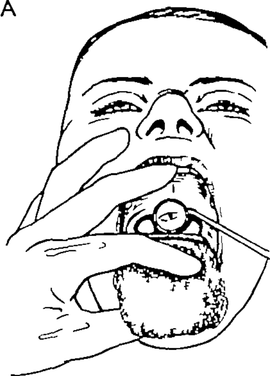
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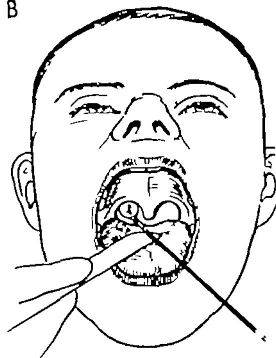
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PLATE 21





C

Laryngoscopy, Nasopharyngoscopy

The surgeon treating diseases of the head and neck must be able to visualize the nasopharynx, hypopharynx, larynx, and cervical esophagus With practice and gentleness, mirror examinations may be accomplished without anesthesia Direct examination requires premedication with a barbiturate drug, and spray or painting of the region with topical anesthetic Only a small amount of topical solution is necessary If it is applied carefully to the mucous surfaces and given a few minutes to take effect, satisfactory anesthesia for examination and biopsy will result

A —Mirror laryngoscopy —The tongue is grasped between the thumb and index finger with a gauze swipe and pulled gently forward Another finger elevates the upper lip A warm laryngeal mirror is introduced with the other hand and moved gently beneath or against the soft palate until the epiglottis and then the interior of the larynx comes into view In addition to the larynx itself, the base of the tongue and lateral pharyngeal walls should be examined in this indirect manner

B —Mirror nasopharyngoscopy —The tongue is depressed and a small mirror is inserted beneath the free edge of the palate for inspection of the nasopharynx and posterior surface of the soft palate If the patient attempts to breathe through his nose, the soft palate will move forward to permit a more adequate view At times, for adequate visualization, it is necessary to anesthetize the pharynx and to pull the soft palate forward with a special palate retractor or a catheter introduced through the nostril and brought out through the mouth

C —Direct laryngoscopy —The patient may be examined in the supine position with the head extended and elevated, or may be seated straddling a chair with his arms folded across the back of the chair The Jackson laryngoscope is passed over the base of the tongue until the operator visualizes the epiglottis The tip of the instrument is directed over the epiglottis and then angled forward into the larynx With adequate anesthesia, the laryngoscope can be passed between the cords for inspection of the subglottic region On withdrawal from the larynx, the instrument can be directed into each piriform recess and into the postcricoid region of the cervical esophagus Lesions of the hypopharynx or larynx may be biopsied with cup-type biopsy forceps through the laryngoscope

BIOPSY

Most lesions of the head and neck are readily accessible and biopsy for diagnostic purposes is a relatively simple procedure As a general rule a portion of every lesion suspected of being malignant should be removed for microscopic examination before definitive therapy is attempted. There are however several important exceptions to this rule which will be discussed in detail in later chapters These exceptions include small skin lesions in accessible locations which may be easily removed in toto with an adequate margin without disfigurement and pigmented tumors suspected of being melanomas which should always be entirely excised Masses in the major salivary glands and in the thyroid should also be removed intact, usually with the involved lobe of the gland

The site on a tumor chosen for biopsy is often of importance One should obtain tissue from the edge of a mass or ulcer at its junction with normal skin or mucosa Tissue removed from the center of a lesion may consist entirely of necrotic debris or granulations

The simplest method of biopsy is the excision of a small portion of tissue using a scalpel and fine forceps This is satisfactory for lesions of the skin, lips, and anterior portion of the oral cavity Local infiltration with procaine usually provides excellent anesthesia Following excision of a small wedge of tissue wounds on the skin or lips may be closed with one or two sutures of fine silk. Small biopsy sites on mucous membranes generally do not require closure Gentle pressure for several minutes will as a rule achieve hemostasis In more remote locations such as the nasopharynx, pharyngeal wall, larynx, or esophagus biopsy is performed with a sharp cup-type or box type biopsy forceps Topical anesthesia with 10% cocaine solution is adequate for this procedure On occasion, the biopsy punch will be found useful, particularly when one wishes to biopsy tissue lying beneath normal mucosa or skin Following local infiltration this instrument can be used to obtain a core of tissue a centimeter or more in depth

The surgeon is frequently called on to biopsy a cervical lymph node or a cervical mass the nature of which is uncertain Two methods of biopsy are available, each of which has definite ad

ROENTGEN DIAGNOSIS

The general surgeon may profitably utilize roentgenograms of the head and neck in a great number of conditions X-ray studies of traumatic lesions are necessary to determine the presence of fractures, foreign bodies, and occasionally air in the tissues Obtaining x-ray films following trauma is of considerable legal importance in addition to being of diagnostic aid In the study of tumors of the soft parts, x-ray films will help in the detection of bone invasion and may contribute valuable information concerning the size and extent of the tumor by demonstrating distortion of neighboring tissues or encroachment on the upper air passages Radiographic studies are also of occasional value in inflammatory conditions and congenital anomalies

Because of the complexity of the bony structure of the cranium, stereoscopic roentgenograms are a necessity for evaluation This is particularly true in the examination of the base of the skull and paranasal sinuses Without stereoscopic views, the overlapping bony shadows make accurate interpretation impossible Skull films should not only be stereoscopic, but should always be taken in both projections, i e , anteroposterior and posteroanterior, as well as in both right and left lateral planes Special projections are useful in demonstrating paranasal sinuses and various bony foramina, and tangential views will often bring out details of fractures, bone cysts, or tumors

The instillation of radiopaque solutions will aid in the diagnosis of tumors, infections, or fistulas of the parotid gland (see Sialography, Chapter 11) A similar technic has been described for delineation of the maxillary antrum Carotid arteriograms aid in the localization and study of intracranial pathology as well as certain traumatic, congenital, and occlusive lesions of the carotid vessels themselves Fluoroscopic observation of a swallow of barium accompanied by spot films will yield information about the pharynx and upper esophagus The column of air following deep inspiration will outline the trachea and larynx and often disclose abnormalities Careful tomography will further aid in the identification of cervical masses A chest roentgenogram should always be a part of the study of the head and neck

In the case of an enlarged cervical node biopsy should be one of the last not the first diagnostic procedures employed In an adult, the possibility of the enlarged node being a site of metastatic cancer is greater than any other likely diagnosis Most primary tumors metastasizing to the neck lie above the clavicles other likely primary sites include the lungs esophagus and breast All reasonable efforts to detect a primary cancer should be carried out before biopsy These include careful examination of the head and neck, laryngoscopy nasopharyngoscopy roentgenograms of the chest and the esophagus and other studies indicated by the patient s symptoms Open biopsy of a node before discovery of the primary tumor will add greatly to the difficulties of later cura tive surgery

When the primary site of cancer in the head and neck is known open biopsy of a suspicious node is not generally recommended unless the surgeon is prepared to go ahead with a radical neck dissection without delay should a frozen section reveal metastatic cancer The incision for the open biopsy should be planned to lie along the same line as that for a neck dissection If metastatic can cer is discovered the surgeon may easily extend the incision or even excise an ellipse of skin at the biopsy site to proceed with the definitive operation It is almost inevitable that tumor cells will be seeded into the wound at the time of open biopsy or excision of a cervical node containing metastatic cancer This fact, plus the scarring and distortion of fascial planes which will occur should further surgery be delayed makes immediate radical neck dissec tion the procedure of choice

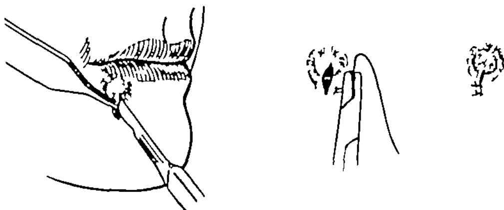
The surgeon is occasionally surprised to discover that the cervical mass he intended to biopsy is not an enlarged lymph node but a primary tumor or cyst For example exposure may reveal the mass to be a tumor of the tail of the parotid salivary gland, a carotid body tumor a branchial cleft cyst, or a schwannoma aris ing from a nerve On such occasions it is usually desirable to proceed with definitive therapy rather than biopsy This is another reason for our conviction that biopsy of a cervical mass should be performed by a trained surgeon with adequate operating facilities at hand.

vantages and disadvantages The first method, open biopsy, requires making an incision over the cervical mass, exposing it, and removing the entire mass or a portion of it for histologic study The pathologist then has the advantage of having a block of tissue for gross examination and for multiple microscopic sections He is able to study not only the individual cells, but also the architectural arrangement of the cells and the stroma in reaching a diagnosis The procedure of open biopsy of a cervical lymph node or mass should be carried out only when there are adequate operating facilities The node is always more deeply located than it seems, and its removal may be complicated by hemorrhage or injury to important structures when attempted without adequate exposure and assistance Following open biopsy of a cervical lymph node, a desmoplastic reaction occurs with scarring, distortion, and obliteration of fascial planes in the surrounding tissues This adds greatly to the difficulty of definitive surgery such as radical neck dissection which may be required later, and may lessen the patient's chance for cure It is important that any incision for an open biopsy be planned to lie along the same line as that for a neck dissection (see Chapter 14) so that the wound may be excised without difficulty at the time of the definitive procedure

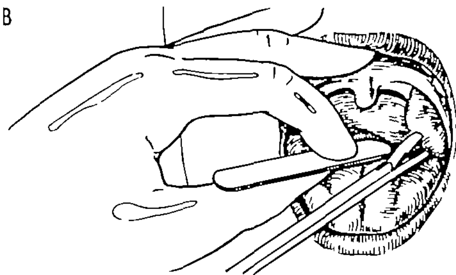
Aspiration or needle biopsy of a cervical lymph node or mass is a useful diagnostic method when its limitations are understood Aspiration of pus, cyst fluid, or tumor cells will often give the surgeon the information he needs The pathologist presented with a thin smear of the aspirated material cannot be expected to make a complete diagnosis in every case However, he can often report that tumor cells are present and, in the presence of a known or previously treated cancer, the report of "tumor cells present" may be all the surgeon wants to know With this evidence that a suspicious cervical mass is metastatic cancer he can proceed with definitive therapy Cervical node involvement by the malignant lymphomas usually cannot be diagnosed by aspiration biopsy, and open biopsy becomes necessary It must be clearly understood that a negative report from an aspiration biopsy does not mean that there is no tumor present If the suspicious mass persists, the aspiration must be repeated, or open biopsy performed

PLATE 3

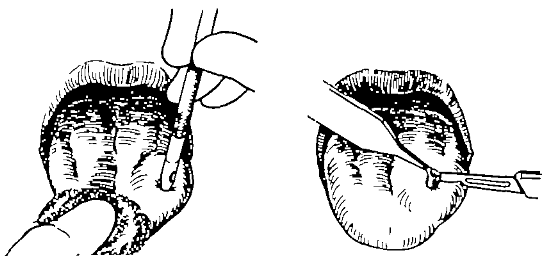
A



B



C



A—Tissue from accessible lesions of the skin and oral cavity may be excised with a knife and forceps under local infiltration anesthesia A small wedge of tissue is removed from the junction of the lesion with normal skin or mucosa On the skin or lips, the wound is closed with one or two fine silk sutures Small incisions on mucous membranes often need not be closed

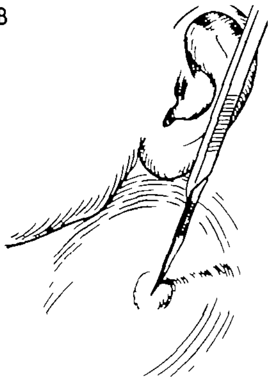
B—In less accessible sites, tissue for examination must be removed with biopsy forceps having a long handle and cup- or basket-type cutting jaws This can be done satisfactorily with topical anesthesia Lesions of the tonsil, pharyngeal wall, and soft palate may be biopsied directly through the oral cavity A biopsy forceps may be introduced through the nasal cavity or the oral cavity for biopsy of the nasopharynx, the position of the instrument being observed with a nasopharyngeal mirror Biopsy of the hypopharynx or larynx is performed through the direct laryngoscope using a long, straight-handled, cup-type forceps

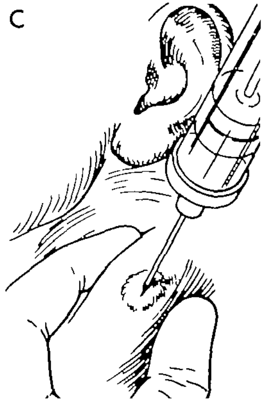
C—The biopsy drill punch is especially useful in obtaining tissue from hard, dense lesions or those covered by intact mucosa Following local anesthesia, the punch is pressed into the tissue while being rotated back and forth The core of tissue thus freed is lifted with a fine forceps and severed at its base with a scalpel or scissors Bleeding usually can be controlled by applying direct pressure over the biopsy site for several minutes

PLATE 4

A

1 2 3 4 5cc.





A—The materials necessary for aspiration biopsy are as follows hypodermic syringe containing 1% procaine, scalpel handle fitted with no 11 blade, aspirating syringe fitted with no 16 or 18 needle, several glass slides, small square of blotter or Gelfoam A regular 10-20 cc glass syringe or a specially constructed aspiration syringe with a metal plunger may be used It is desirable to have a small instrument available to scrape out tissue from the barrel of the syringe

B—With the patient recumbent, which allows access to the cervical mass, the overlying skin is prepared with an antiseptic solution A skin wheal of procaine is raised over the mass with the hypodermic syringe The scalpel is used to make a small stab wound through the center of the anesthetized area

C—The cervical mass is outlined and immobilized by the fingers of one hand The aspirating needle attached to the syringe is then introduced through the stab wound and directed into the center of the mass Strong suction is applied to the syringe During application of suction, the needle may be moved gently up and down several times within the mass Suction is released and the aspirating syringe removed A small gauze dressing is applied with a strip of adhesive Any oozing from the wound will cease with a moment's direct pressure The material in the aspiration syringe is smeared on one or more glass slides The pathologist can study the preparation more easily if thin smears are obtained The slides may be air dried for later staining, or may be fixed in an alcohol-ether solution similar to that used for Papanicolaou smears If bits of tissue or blood are aspirated in the syringe, they may be placed on the square of blotter or Gelfoam and immersed in formalin for sectioning by the pathologist

There is little evidence that aspiration biopsy spreads tumor cells or distorts fascial planes as does open biopsy The site of the needle puncture should be planned, however, so that the needle tract may be excised at the time of neck dissection should definitive surgery become necessary

PLATE 4

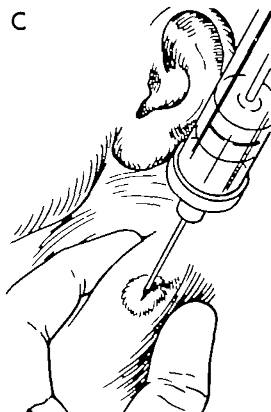
A

1 2 3 4 5cc.

B



C



CHAPTER 3

Preoperative and Postoperative Care; Anesthesia

PATIENTS tolerate surgical procedures in the region of the head and neck surprisingly well The mortality from extensive surgery in this area is extremely low, even in groups of patients of advanced age and with complicating cardiovascular diseases Many patients on whom the surgeon would hesitate to perform a laparotomy or thoracotomy will withstand major head and neck operations without difficulty

PREOPERATIVE CARE

The morbidity from operations on the head and neck can be reduced and some postoperative complications prevented by adequate preoperative care This care includes evaluation and improvement of the patient's general status as well as management of local conditions Studies of the patient's cardiovascular system should be carried out when indicated Evidences of cardiac decompensation should be corrected and a normal cardiac rhythm established if possible Disturbances in pulmonary physiology, often present in patients with disease of the head and neck, should be treated by postural drainage, use of expectorant drugs and by aerosol inhalations of antibiotics and wetting agents When partial obstruction of the upper respiratory tract is present, a tracheostomy may be indicated for adequate treatment of pulmonary complications before definitive surgery is carried out

At times the patient being prepared for head and neck surgery is in a marked state of depletion because of painful or difficult swallowing the presence of fistulas or of chronic infection The deficiency includes total blood volume extracellular fluids and electrolytes and vitamins Vigorous replacement therapy carried out before surgery will not only provide for greater safety during the operative procedure but will result in a smoother postoperative course. Several transfusions of whole blood may be necessary to restore blood levels to normal When an extensive operation is contemplated it is occasionally profitable to carry out blood volume studies using the Evans blue dye method or one of the other available technics This will permit more accurate preoperative replacement therapy and will also serve as a base line should further studies be desired to estimate blood loss during surgery Manifest or latent vitamin deficiencies should be corrected by multivitamin preparations administered orally or parenterally The nutritional status of patients who have been unable to take adequate oral feedings for some time can be greatly improved by nasal tube feedings using a high caloric feeding mixture

Local infection in the head and neck is a frequently encountered preoperative problem Every effort must be made to eradicate infection before surgery The use of antibiotic agents will frequently clear up local infections as well as reduce the inflammatory reaction around tumors The frequent use of gargles irrigations and sprays will do much to reduce intra-oral sepsis Although antibiotic solutions may be applied locally in the oral cavity we have found that mechanical cleansing and the use of saline irrigations are equally effective

POSTOPERATIVE CARE

Successful postoperative management of patients who have undergone extensive head and neck surgery requires careful observation by the surgeon as well as expert nursing care In the early postoperative period, the airway is often of prime importance Restlessness of the patient or the slightest inspiratory stridor should warn those in attendance of the possibility of laryngeal edema, and facilities always must be available for an emergency tracheostomy

CHAPTER 3

Preoperative and Postoperative Care; Anesthesia

PATIENTS tolerate surgical procedures in the region of the head and neck surprisingly well The mortality from extensive surgery in this area is extremely low, even in groups of patients of advanced age and with complicating cardiovascular diseases Many patients on whom the surgeon would hesitate to perform a laparotomy or thoracotomy will withstand major head and neck operations without difficulty

PREOPERATIVE CARE

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spoon introduced well back in the mouth After several days trial most patients will be able to tolerate oral feedings Patients with considerable anatomic distortion and loss of tissue must be kept on

TUBE FEEDING FORMULAS

FORMULA 1

Milk	1 quart	1 000 cc contains	
Eggs	4	Calories	1 018
Skim milk powder	100 Gm (¾ cup)	Protein	63 Gm
Sugar	50 Gm (¼ cup)	Fat	40 Gm.
		Carbohydrate	99 Gm.

FORMULA 2

10% Milk	1 quart	1 000 cc contains	
Eggs	6	Calories	1 601
Corn sirup	120 Gm (6 tbsp)	Protein	55 Gm
Skim milk powder	50 Gm. (8 tbsp)	Fat	99 Gm
Salt	5 Gm (1 tsp)	Carbohydrate	123 Gm.
Brewer s yeast	5 Gm (2 tsp)		
Ascorbic acid	200 mg		

SKIM MILK FORMULA

Skim milk powder	240 Gm. (2 cups)	1 000 cc contains	
Water	3 cups	Calories	694
		Protein	68 Gm.
		Fat	2 Gm.
		Carbohydrate	100 Gm.

tube feedings Many foods in the ordinary diet can be liquefied with an electric food blender and given to the patient who is un able to handle solids

Analgesia —It is often surprising to the physician unfamiliar with head and neck surgery how little pain the patient has fol lowing even the most extensive procedures Postoperative discom fort may be relieved adequately in most cases by aspirin given orally or through the feeding tube Narcotics are undesirable be- cause of depression of respirations and inhibition of the cough reflex. This is of particular importance following operations in which there is temporary loss of the normal swallowing reflex allowing aspiration of blood and saliva The patient whose pain is

should this become indicated (see Tracheostomy, Chapter 4)

Antibiotics are used in the postoperative period only when the operative wound is contaminated or when evidence of infection appears Since inevitable contamination of the wound occurs whenever the upper respiratory or gastrointestinal passages are entered, antibiotics are administered prophylactically after operations of this nature We generally use a combination of penicillin and streptomycin for a period of 5 days or longer, when indicated

Postoperative feeding —Many patients who have suffered traumatic wounds or who have undergone extensive surgery are unable to swallow adequately for varying lengths of time Their nutritional status can be maintained adequately by nasal tube feedings started on the first postoperative day and continued until swallowing becomes efficient Feedings are given through a small-caliber rubber or plastic catheter introduced through the nostril We prefer a naso-esophageal catheter 40 cm in length for tube feedings, a longer nasogastric tube is also satisfactory

It is often helpful to introduce the feeding tube in the operating room at the time of surgery, since insertion later may be quite difficult due to edema of the tongue and pharynx Once a tube has been inserted, the surgeon should personally ascertain its correct position, testing with a small amount of water or Dakin's solution before feedings are instituted

Tube feedings are administered 4 times daily The feeding solution is placed in an ordinary intravenous solution flask which is connected to the nasal tube and is allowed to drip in at a rate of about 100 drops per minute Following each feeding, a few ounces of water are added to rinse out the tube and to maintain an adequate fluid intake Feeding solutions of about 250 cc each are started on the first postoperative day If they are well tolerated, the volume is increased to 500 cc, given 4 times daily thereafter

The first two of the tube feeding formulas shown here have been found satisfactory Either one may be used, depending on the caloric intake desired Some patients cannot tolerate these feedings and must be given the concentrated skim milk formula instead

As edema subsides and function of the jaws and tongue improves, the patient is encouraged to start swallowing This is best accomplished by gradual attempts to swallow water from a tea-

spoon introduced well back in the mouth After several days trial most patients will be able to tolerate oral feedings. Patients with considerable anatomic distortion and loss of tissue must be kept on

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not controlled by aspirin is given small doses of Demerol and one of the barbiturate drugs

Nursing care—A nurse who is familiar with head and neck surgery is an asset in the management of these patients She can contribute greatly to an uneventful postoperative course by proper care of the tracheostomy, administration of tube feedings, and by spray and suction of intra-oral wounds

If the nurse is unfamiliar with the operation performed, careful explanation of what has been done and explicit instructions for care of the patient are necessary Early signs of impairment of the airway must be clearly understood If a tracheostomy tube has been used, its management should be demonstrated, including the technic of suctioning the tube and of changing the inner cannula A demonstration of the method of suctioning the mouth may also be necessary The nurse should be informed of the location of intra-oral suture lines or packs so that they will not become traumatized or dislodged

Sympathetic management of many of these patients is essential during their recovery from surgery The psychologic impact of major head and neck procedures is often severe The fear of disfigurement plus difficulties with talking, swallowing, or vision in the postoperative period may lead to panic The nurse must make every effort to establish communication with the patient and to reassure him as much as possible For example, temporary occlusion of a tracheostomy tube to convince the patient he has not lost his voice, or the calm assurance that everything is going well, may often restore peace of mind

Wound care—Meticulous attention to surgical wounds of the head and neck is necessary Following major procedures, the dressing should be changed and the wound inspected each day unless a skin graft has been used Collections of blood or serum beneath the skin flaps must be detected and promptly evacuated Drainage of purulent material, chyle, or saliva from wounds should be noted and prompt corrective steps taken (Chapter 4)

When drains have been used, they are generally withdrawn on the 3d or 4th postoperative day An effort is made to remove skin sutures as early as possible from facial wounds If a careful wound

closure has been performed, and tissues are healthy the skin sutures may all be removed in from 3 to 5 days In situations where there is a question of the viability of tissues or where prior irradiation has been employed the skin sutures are left in place for longer periods Sutures in mucous membranes are usually removed in from 7 to 10 days

Particular attention must be given to wounds of the oral cavity because of the large number of bacteria normally present. With improper care the mouth quickly becomes dirty with ensuing edema and maceration of the tissues a thick exudate and a fetid odor which leads to delayed wound healing and development of fistulas It can be prevented by adequate spray or irrigation, and mechanical cleansing at least once and preferably twice daily Additional details regarding wound care and dressings are given on the following pages

Postoperative Suction and Spray

A.—An efficient suction apparatus is essential for bedside care of patients undergoing major head and neck surgery The suction tubing is attached to a Y-shaped glass connection which is then attached to a rubber or plastic catheter for suction of the trachea and a metal tonsil suction tip for aspiration of the mouth and pharynx The catheter for tracheal suction should be of the whistle-tip type with an open end

Suction of the oropharynx and the trachea should be performed as often as secretions accumulate The mouth and pharynx are aspirated by means of the metal suction tip introduced gently and passed along the floor of the mouth and over the base of the tongue into the pharynx The catheter for tracheal suction is introduced through the nostril or through the tracheostomy tube It is wise to carry out tracheal suction for short intervals only, allowing the patient frequent rest periods to avoid anoxia A moist sponge suspended over the tracheostomy tube helps prevent drying and crusting of secretions The inner liner of the tube should be removed at least once daily, carefully scrubbed, and reinserted

B.—Intra-oral wounds and suture lines are cared for by irrigation and cleansing This is best accomplished by use of a spray and suction apparatus A fine spray of saline solution is systematically applied to the entire oral cavity A metal suction tip is passed simultaneously over the sprayed surfaces to aspirate the solution and any debris or exudate present If a headlight is worn during this process, the oral cavity will be well illuminated and suture lines may be inspected If the spray and suction is repeated twice daily, intra-oral wounds remain clean and the distressing odor of necrotic debris in the mouth is avoided Irrigation of the mouth with a bulb syringe is satisfactory if a pressure spray apparatus is not available

PLATE 5

A

B

Dressings

A —Small surgical wounds of the face seldom need more than a light temporary dressing The dressing may be removed after 24 hours and the wound exposed Surgical wounds of the lips are generally managed without dressings In wounds of the skin of the face, where the cosmetic result is important, skin sutures should be removed early, on the 3d or 4th postoperative day Temporary support can then be given by strips of fine mesh gauze placed across the wound and fixed to the adjacent skin surfaces with collodion Fine strips of adhesive are also satisfactory to remove tension from the wound edges

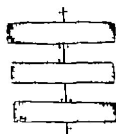
B —Free skin grafts applied to the head and neck must be kept in place by moderate pressure A satisfactory method to hold the graft in position is to cover it with a single layer of fine-mesh petrolatum gauze backed by a thick layer of dry gauze The long ends of sutures holding the edges of the graft are then tied over the gauze stent An additional larger dressing may then be applied to further protect the area

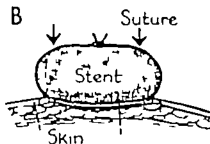
C —Following extensive wounds of the head and neck, or major surgical procedures such as a radical neck dissection, a bulky pressure dressing must be applied Gauze is applied to the wound edges and is covered by sterile mechanic's waste to provide even pressure A roll of wide gauze similar to that applied to the extremities following amputation is then wrapped snugly around the neck To maintain a neck dressing in place, it is best to wrap several turns of the gauze roll around the head The dressing is then covered with elastic adhesive wrapped around the neck and anchored to the chest wall

D —Wounds of the scalp, if extensive, require a complete head dressing Smaller incisions may be covered by a small dressing of light gauze The dressing is held in place by a single layer of loose-mesh gauze fixed to the surrounding scalp with collodion

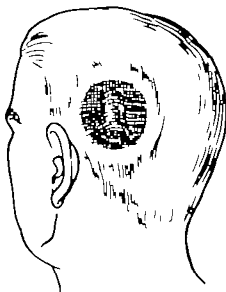
E —Incisions following thyroidectomy may be dressed by dry gauze applied to the wound and held by a wide strip of adhesive tape around the lower neck, the ends of the tape being crossed and fixed to the chest A layer of gauze is applied to the adhesive posteriorly to prevent its adhering to the back of the neck

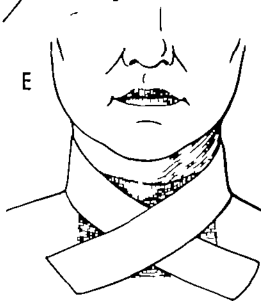
PLATE 6











A.—Small surgical wounds of the face seldom need more than a light temporary dressing The dressing may be removed after 24 hours and the wound exposed Surgical wounds of the lips are generally managed without dressings In wounds of the skin of the face, where the cosmetic result is important, skin sutures should be removed early, on the 3d or 4th postoperative day Temporary support can then be given by strips of fine mesh gauze placed across the wound and fixed to the adjacent skin surfaces with collodion Fine strips of adhesive are also satisfactory to remove tension from the wound edges

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rine should be omitted if the patient is suffering from hypertension hyperthyroidism, or heart disease

Regional block—A number of technics for regional nerve block are available to provide analgesia in different sites in the head and neck. These include block of the supra orbital and supra trochlear nerves infra-orbital nerve block, mandibular or mental nerve block maxillary nerve block, and block of the cervical plexus Some of these procedures are quite simple to perform and are extremely useful for many short operations on superficial tissues Infra-orbital and mandibular blocks in particular give adequate anesthesia for most operations on the upper and lower lips and, in many instances one of these blocks may be the anesthetic of choice

Endotracheal anesthesia—The use of an endotracheal tube is mandatory for some major head and neck procedures and has been of tremendous aid in the performance of many others This advance in the management of the anesthetic problem has a number of advantages The anesthesiologist is able to care for the patient at a distance from the operative field an anesthetic mask is unnecessary and the surgeon and anesthesiologist need not compete for space to perform their tasks The use of the endotracheal tube has largely done away with the problems of aspiration and airway obstruction during surgery An inflatable cuff at the distal end of the tube prevents aspiration of blood or mucus during procedures carried out in the mouth pharynx, or nasal passages Obstruction of the airway by pressure laryngospasm, or by extreme flexion or rotation of the neck is prevented by the endotracheal tube

With the endotracheal tube in place and its cuff inflated, a closed system is achieved for administration of the anesthetic agent In many patients excellent anesthesia for major head and neck procedures is obtained by intravenous Pentothal sodium supplemented by endotracheal nitrous oxide and oxygen If desired, a gas-oxygen-ether mixture or cyclopropane may be administered via the tube Of course such explosive mixtures cannot be given when the surgeon plans to use the electrocautery

ANESTHESIA

The choice of anesthetic depends on the anatomic area involved and the extent of the procedure The general status of the patient, the preference of the surgeon, and the skill of the anesthesiologist also will affect the modality selected

Carefully planned preliminary medication will contribute to successful anesthesia Barbiturates should be given if possible at least 1 hour before any type of anesthetic to induce sedation as well as to protect against convulsive reactions which may at times be incited by local anesthetic agents Analgesic drugs such as morphine or Demerol are also necessary in all but the most minor procedures Atropine or scopolamine are given at the same time as the analgesic to reduce reflex activity and excessive secretion of mucus Scopolamine has the additional value of inducing a certain degree of amnesia

Topical anesthesia—Topical agents are used effectively for many operations involving mucous membranes They are the agents of choice for most endoscopic procedures in adults and are particularly useful for surgery in the nasal cavity Cocaine in a 10% solution is the most generally used, pontocaine in a 2% solution is a satisfactory substitute The agents are generally applied with cotton pledgets on applicator sticks or fine curved forceps They also may be administered in a fine spray from an atomizer When the latter method is selected, the solution in the atomizer must be measured accurately and care taken that an excessive amount is not consumed Because of the possibility of an untoward reaction accompanying the use of any topical agent, it is important that a supply of oxygen and a quick-acting intravenous barbiturate drug be available for immediate use

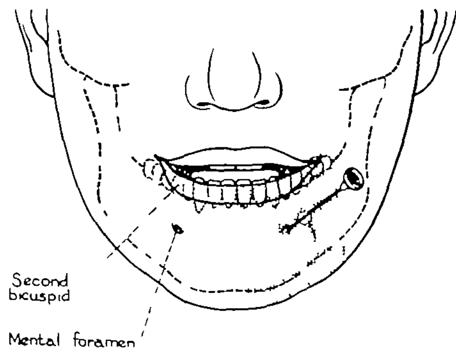
Local infiltration—The use of procaine hydrochloride injected locally is satisfactory for a wide variety of minor procedures in the head and neck This agent is generally used for biopsy or excision of lesions of the skin or of the mucous membrane of the oral cavity A 1 or 2% solution of procaine is safe for injection For vasoconstriction and prolongation of anesthesia, the procaine may be mixed with epinephrine The amount of the latter should not exceed 0 1 cc of 1 1,000 solution per 100 cc of procaine Epineph-

PLATE 7

A

Infra orbital foramen

Canine



Infra-orbital nerve block.—*A*.—The infra-orbital foramen is located by palpation just below the infra-orbital ridge of the maxilla about 2 cm lateral to the side of the nose (It helps to localize the foramen by recalling that it is directly above the canine fossa and on a line between the canine tooth and the pupil when the eye is in a central position) The skin is anesthetized just below and medial to the foramen so that the needle can be introduced in the plane of the infra-orbital canal which inclines upward and outward A 22-gauge needle is directed into the foramen and about 0 5 cm farther into the infra-orbital canal Paresthesia of the upper lip and ala of the nose usually occurs Adequate anesthesia is obtained by injecting 1 cc of 2% procaine into the canal and an additional 1-2 cc at the infra-orbital foramen The anesthesia extends over the full thickness of the upper lip as well as the skin of the cheek and lower eyelid A bilateral infra-orbital block is needed for operations near the midline of the upper lip

Mental nerve block.—*B*.—The mental foramen in an adult with his own teeth lies midway between the upper and lower edges of the mandible opposite the second bicuspid tooth In an older or edentulous patient, the foramen lies closer to the upper edge of the mandible The foramen is usually palpable The skin is anesthetized slightly superior and posterior to the position of the foramen A 22-gauge needle is then introduced at an angle of 45 degrees to the skin so that when the foramen is located with the point of the needle, the canal which inclines forward and downward may be entered Paresthesia in the lower lip is usually noted by the patient About 2 cc of procaine is injected at the mental foramen and an additional 1-2 cc within the canal Anesthesia of the chin, lower lip, and anterior gum results

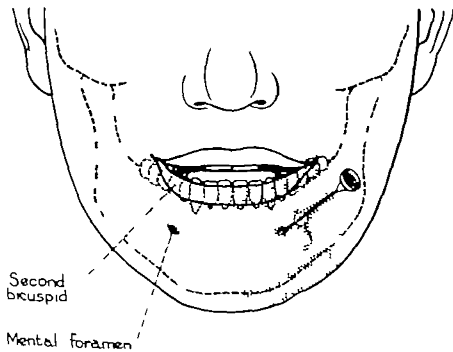
[Regional nerve blocks *continued on page 50*]

PLATE 7

A

Infra orbital foramen

Canine



Mandibular nerve block—This block provides excellent anesthesia for many operations on the skin of the chin, the lower lip, gum, floor of the mouth, and tongue The approach described is used by most dentists and is not difficult An external approach through the notch of the mandible may also be used

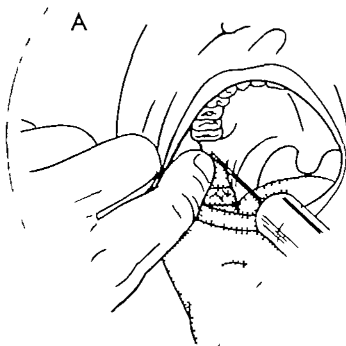
A—With the patient in a sitting position and the mouth opened widely, the operator's index finger is placed in the retromolar area over the ascending ramus of the mandible The finger tip is held just at the internal oblique ridge of the mandible, which is palpable just posterior to the anterior border of the ramus The finger serves to define the point of injection and to retract the buccal fat pad

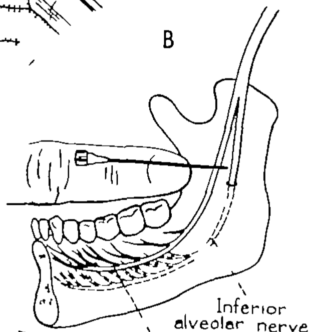
B—A syringe containing 2% procaine and mounted with a 1⅝-inch, 22-gauge needle is introduced from the opposite corner of the mouth over the bicuspid teeth The syringe should be parallel to the occlusive plane of the mandibular teeth The needle is introduced just beyond the center of the operator's fingernail The mucosa is anesthetized and the needle advanced about one half inch Paresthesia in the lip or gum indicates that the inferior alveolar branch of the mandibular nerve has been touched If bone is contacted, the needle is withdrawn slightly A total of 6-8 cc of procaine is injected while the needle point is slowly moved in and out Complete anesthesia is accomplished in 5-10 minutes A bilateral mandibular block is needed whenever the operative field comes near the midline

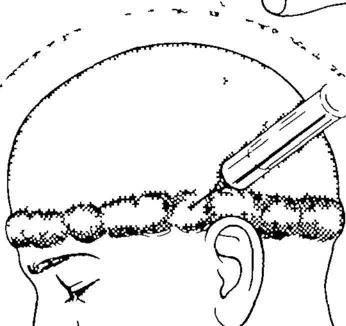
Scalp block—*C*—Many operations on the scalp, skull, and brain may be performed with anesthesia obtained by a scalp block The branches of the trigeminal and upper cervical nerves which supply the scalp course rather superficially in the subcutaneous tissue A block at this level secures anesthesia of the scalp as well as the pericranium The dura and the brain are insensitive

In the performance of a scalp block, multiple wheals may be raised with a short needle, or a long flexible needle may be used for circuminjection with but a few punctures A procaine-epinephrine solution is generally used, 1-2 cc of solution being injected per inch of advancement of the needle A limited scalp block is satisfactory for minor procedures located well away from the midline

PLATE 8







Endotracheal Anesthesia

Endotracheal tubes may be introduced through the mouth, the nostril, or through incisions in the trachea Before induction, it is of value to spray the hypopharynx with a topical anesthetic agent to reduce reflex spasm during insertion of the tube The patient is then anesthetized with Pentothal sodium or nitrous oxide Intravenous use of one of the muscle relaxants such as tubocurarine or succinylcholine is then of considerable aid in exposure of the larynx and introduction of the tube The above procedure is safe whenever an adequate airway exists but should *never* be carried out when there is partial obstruction of the airway and some uncertainty as to the ease of intubation Under the latter condition, the patient must not be put to sleep until the endotracheal tube is inserted, using topical anesthesia only

A —When the surgical field does not include the oral cavity, an endotracheal tube is best introduced through the mouth with the larynx exposed by a laryngoscope

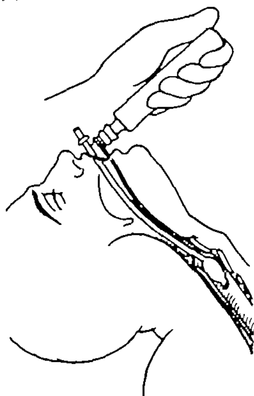
B —If the surgeon plans to enter the oral cavity, a curved nasotracheal tube without a cuff should be introduced through the nostril This can be introduced into the larynx "blindly" or the anesthesiologist may visualize the larynx with a laryngoscope and guide the tube with a curved clamp A pack of moist gauze is placed in the pharynx around the tube to prevent aspiration It is important that the pack be removed at the conclusion of the operation before the tube is withdrawn

C —The endotracheal tube is connected to the hose of the anesthetic apparatus by a straight or curved adapter Following this, the skin in the operative field is scrubbed and prepared for surgery Two small sterile sheets are place beneath the patient's head

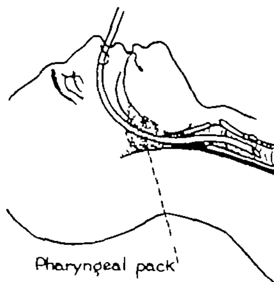
D —The upper sheet is lifted and wrapped around the patient's head and the anesthetic connections The chest and shoulders are then draped, affording a free, sterile operative field

PLATE 9

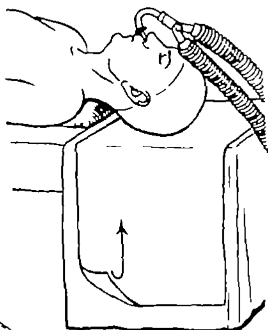
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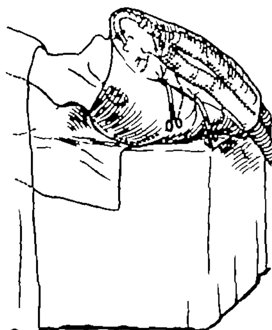
B



C



D



Endotracheal Anesthesia

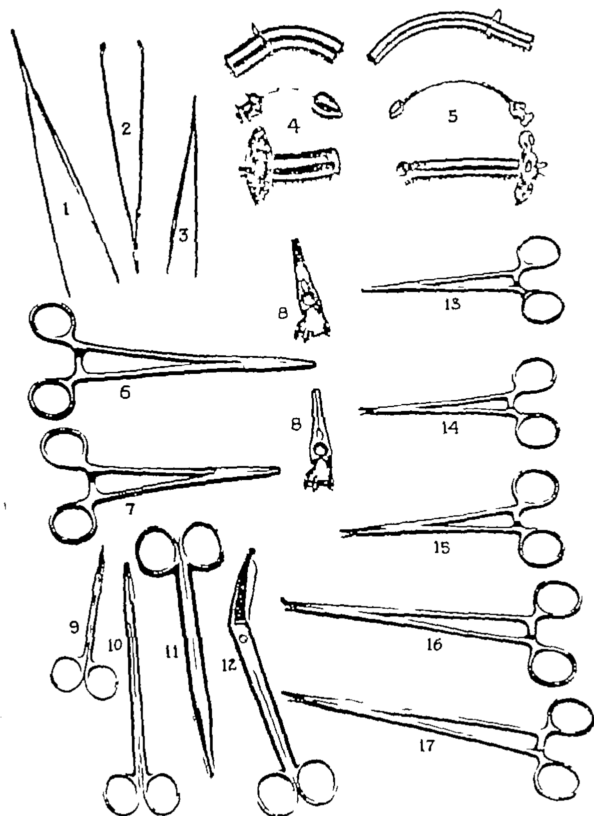
Endotracheal tubes may be introduced through the mouth, the nostril or through incisions in the trachea. Before induction, it is of value to spray the hypopharynx with a topical anesthetic agent to reduce reflex spasm during insertion of the tube. The patient is then anesthetized with Pentothal sodium or nitrous oxide. Intravenous use of one of the muscle relaxants such as tubocurarine or succinylcholine is then of considerable aid in exposure of the larynx and introduction of the tube. The above procedure is safe whenever an adequate airway exists but should *never* be carried out when there is partial obstruction of the airway and some uncertainty as to the ease of intubation. Under the latter condition, the patient must not be put to sleep until the endotracheal tube is inserted using topical anesthesia only.

A.—When the surgical field does not include the oral cavity, an endotracheal tube is best introduced through the mouth with the larynx exposed by a laryngoscope.

B.—If the surgeon plans to enter the oral cavity, a curved nasotracheal tube without a cuff should be introduced through the nostril. This can be introduced into the larynx "blindly" or the anesthesiologist may visualize the larynx with a laryngoscope and guide the tube with a curved clamp. A pack of moist gauze is placed in the pharynx around the tube to prevent aspiration. It is important that the pack be removed at the conclusion of the operation before the tube is withdrawn.

C.—The endotracheal tube is connected to the hose of the anesthetic apparatus by a straight or curved adapter. Following this, the skin in the operative field is scrubbed and prepared for surgery. Two small sterile sheets are place beneath the patient's head.

D.—The upper sheet is lifted and wrapped around the patient's head and the anesthetic connections. The chest and shoulders are then draped, affording a free, sterile operative field.


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Instruments for Head and Neck Surgery

Plates 10 and 11 illustrate some of the instruments commonly used for head and neck procedures Most of these instruments may be found in any well-equipped operating room In the listing below, the surgeon's name associated with the instrument is given with some of the items For others, the exact nomenclature is not specified, since a number of similar instruments are available with different names and only minor modifications

1 Fine straight forceps (Cushing)

2 Tissue forceps (Martin) These are very adaptable The fine teeth prevent slipping, yet the forceps are relatively atraumatic and may be used to handle blood vessels

3 Small tissue forceps (Adson) For fine dissection and plastic procedures

4 Laryngectomy tube with extension (Martin) This is shorter and has less curve than the tracheostomy tube Size no 12 generally used

5 Tracheostomy tube with extension (Martin) The extension on the inner cannula is of value when a bulky dressing must be applied Size no 6 or 8 generally used for adults

6 Needle holder

7 Small needle holder

8 Bulldog clamps (Potts-Jahnke) The thumbscrew on these clamps allows alterations in pressure to be applied For temporary occlusion of vessels

9 Small curved iris scissors An aid to fine dissection, particularly in isolation of facial or recurrent laryngeal nerves

10 Curved dissecting scissors (Metzenbaum)

11 Dissecting scissors (Mayo)

12 Ball-point laryngeal scissors Useful for partial laryngectomy

13 Straight mosquito forceps

14 Curved mosquito forceps

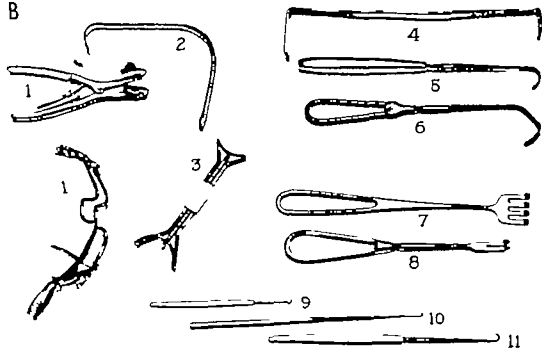
15 Small curved hemostat (Crile) We have found this type most useful for hemostasis At least 100 should be available for a major procedure

16 Gall duct forceps (Lahey or Mixter) Useful for pulling ligatures around vessels

17 Tonsil artery forceps (Boettcher) For clamping vessels in the depths of a wound

A

1 2 3 4 5 6 7



A —Bone Instruments

1 Curettes A number of sizes and shapes are needed Malleable handles are useful for curettage of paranasal sinuses
2 Motor saw The Stryker saw with an oscillating rather than a rotating blade is most useful
3 Osteotome
4 Chisel
5 Gigli saw
6 Bone-cutting forceps
7 Rongeur Several sizes needed

B —Retractors

1 Mouth gags A number of modifications are available for spreading the jaws during intra-oral procedures
2 Tongue depressor
3 Cheek and lip retractor
4 U S Army retractor
5 Vein retractor
6 Loop retractor (Cushing) Valuable for retracting muscle masses or large vessels
7 Large rake retractor
8 Small rake retractor
9 Shepherd's hook For gentle retraction of skin edges Valuable for plastic procedures
10 Nerve hook
11 Tracheal hook Useful for lifting and stabilizing trachea during performance of tracheostomy

Skin Necrosis

The skin of the head and neck has a rich vascular supply and wound necrosis is uncommon It is only when operating in a heavily irradiated area, or when rotating or sliding large skin flaps that danger of slough of the skin will arise Skin that has been heavily irradiated is fibrotic with sparse blood supply and necrosis is likely to follow wide undermining or closure under tension It is well to anticipate skin necrosis under such circumstances and to plan incisions so that important underlying structures particularly the carotid artery will not be exposed if slough of the wound edges should occur

Hemorrhage

Because of the rich blood supply of the head and neck, wound hemorrhage is an occasional problem It can usually be prevented by meticulous hemostasis during surgery Inadequate hemostasis if not recognized, may lead to serious complications Extensive hematomas beneath skin flaps will interfere with healing and lead to prolonged infection Following thyroid surgery or incisions in the hyoid region, hematomas may cause obstruction of the trachea or larynx and sudden asphyxia

Hemorrhage from the carotid artery is one of the most serious complications of major procedures on the head and neck. The artery may be inadvertently injured during surgery particularly in the presence of inadequate incisions with poor exposure Removal of a carotid body tumor or attempts to separate an adherent cancer from the artery may also lead to sudden hemorrhage Temporary occlusion of the artery will allow small tears to be repaired with fine arterial silk. Bleeding from the carotid artery in the post operative period also occurs occasionally Such hemorrhage is usually the result of infection and necrosis of the wall of the artery exposed in a sloughing wound or bathed in pharyngeal secretions Postoperative hemorrhage usually must be contolled by ligation and division of the artery

Ligation of the common or internal carotid artery may be neces sitated by hemorrhage or on rare occasions by deliberate sacrifice

CHAPTER 4

Operative Complications. Tracheostomy

At the time of, or following, operative procedures on the head and neck, a variety of complications may appear, many of them peculiar to surgery in this region. Some complications, particularly obstruction of the airway, often may be anticipated and prevented. Others may be unavoidable, and must be detected and treated early to forestall a disaster or prolonged convalescence.

Wound Infection

During the course of many head and neck operations, when the operative field extends into the oral or nasal cavities, the pharynx, or the esophagus, there is unavoidable contamination of the wound. Before the era of antibiotics, these procedures were accompanied by a high morbidity and mortality due to wound sepsis. Serious wound infections of the head and neck are less common today with prophylactic antibiotic therapy. However, too great reliance should not be placed on antibiotics alone for the prevention of wound infection. Of equal importance is gentle handling of tissues, hemostasis, obliteration of dead space, and judicious use of drains. Low-grade wound infections, manifested by slight purulent discharge or edema and erythema of the wound edges may occur occasionally. The infection usually responds to adequate drainage, moist applications, and the use of a specific antibiotic agent determined by bacterial sensitivity studies.

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Ligation of the common or internal carotid artery may be necessitated by hemorrhage or on rare occasions by deliberate sacrifice

of the artery because of invasion by tumor Ligation is followed in almost 25% of cases by serious neurologic sequelae, and in about half of these, by death The neurologic changes, due to cerebral ischemia, may immediately follow carotid ligation, or may be delayed as long as 1 week The occurrence of hemiplegia following carotid ligation is difficult to predict It depends on a number of factors, including the efficiency of the collateral circulation from the opposite internal carotid through the circle of Willis Another factor exercising considerable influence on the outcome of carotid ligation is the presence of shock from blood loss This must be prevented or vigorously treated The use of anticoagulant drugs is of little or no aid in the prevention of neurologic sequelae When carotid ligation has been performed, the patient must be kept in bed in a recumbent position for at least 7 days, since even elevation of the head has been known to be followed by signs of cerebral damage

Fistulas

A number of troublesome fistulas may arise to complicate surgery of the head and neck These include fistulas from the oral cavity, the maxillary antrum, the pharynx, cervical esophagus, parotid gland, and thoracic duct The fistulas are usually of little significance and early spontaneous closure may be expected Persistent and profuse drainage at times, however, constitutes a major problem In such cases, nutrition is interfered with, nursing care becomes difficult, wound healing is delayed, and the patient's life may be threatened

Oral, pharyngeal, and esophageal fistulas are due to poor wound healing which may stem from a number of causes The removal of a large volume of tissue necessitating wound closure with undue tension is a major predisposing factor Wound infection, particularly in the presence of inadequate drainage, will lead to breakdown of suture lines and fistula formation Fistulas are also prone to develop in tissues which have been previously subjected to heavy external or interstitial irradiation In operating on patients who have received radiotherapy, the surgeon must be particularly concerned with these complications and must plan incisions and

wound closures to prevent them or minimize their effects When vulnerable suture lines exist in the posterior portion of the oral cavity or in the pharynx or esophagus, oral feedings should be avoided for 5 to 7 days following surgery in an attempt to prevent fistula formation The patient is maintained on tube feedings until there is evidence that wound healing is proceeding satisfactorily Small liquid feedings are then started cautiously by mouth If no difficulty is encountered within 48 hours the diet is increased

Most fistulas from the mouth pharynx, or esophagus appear within 10 days following surgery Their first evidence is the drainage of mucus saliva, or ingested food from the wound Once a fistula is detected it is important to obtain free drainage to avoid infection and extensive undermining of skin flaps The draining angle of the wound must be enlarged if drainage seems inadequate The patient is kept on tube feedings to avoid impaction of food particles in the fistulous tract. Small sips of water at intervals however aid in irrigation of the tract once it is well established

If drainage is adequate most fistulas will close spontaneously within a few weeks of their appearance Premature attempts at closure will be unsuccessful and will be followed by further loss of tissue Occasionally a large fistula, particularly in an irradiated wound, will require staged plastic procedures for its closure This can sometimes be accomplished by rotation of a flap of adjacent skin lined by a split thickness graft Often however there is not enough healthy tissue locally available for such closure and a tubed pedicle must be constructed on the chest and migrated in stages to cover the defect

Parotid duct fistulas occur occasionally following parotid surgery or surgery of the cheek they are more common following traumatic wounds in the parotid region Practically all postoperative parotid fistulas close spontaneously with conservative management A rare postoperative fistula and an occasional fistula following trauma which persists for over a month may require operative closure The severed ends of the duct must be identified and joined over a filiform catheter introduced from the duct opening in the buccal mucosa When loss of substance of the duct prevents approximation, the duct ends should be ligated. The parotid swelling which results will subside spontaneously

Operative Complications: Chylous Fistula, Pneumothorax

A —Chylous fistulas are occasionally encountered following surgery in the lower neck They interfere with wound healing and may cause a dramatic deterioration in the patient's condition because of loss of large volumes of lymph Most chylous fistulas can be prevented at the time of surgery Although the major lymphatics may be difficult to visualize, the surgeon is forewarned by the knowledge of their proximity to the jugular-subclavian junction The slow accumulation of puddles of clear, watery or slightly cloudy fluid in this region indicates that a major lymphatic has been severed Careful inspection of the wound will disclose a strand of friable tissue 1-2 mm in diameter from which the chyle is oozing The ducts must be clamped and ligated until no further accumulation of chyle occurs If the duct injury is not detected at surgery, its first sign will be a profuse drainage of cloudy pink fluid from the wound on the 1st or 2d postoperative day Occasionally, control of the fistula may be achieved by heavy pressure dressings and by discontinuing oral feeding If these measures are not successful within a few days, the wound must be reopened and the draining lymphatic ducts ligated Identification of the ducts will be facilitated if a meal of cream is given before surgery

B —An infrequent but serious complication of surgery in the lower neck is the development of a pneumothorax This complication is not, as a rule, due to direct injury to the pleura over the cupola of the lung, but to air which has entered by way of the mediastinum Whenever the middle layer of the deep cervical fascia is incised, there is a direct anatomic pathway providing free passage into the mediastinum If at this stage there is partial respiratory obstruction due to laryngospasm, mucus secretion, or poor anesthesia, air will be sucked down into the mediastinum to accumulate under pressure As the mediastinal emphysema increases, rupture of the thin mediastinal pleura leads to a unilateral or bilateral pneumothorax The development of unexplained respiratory distress, cyanosis, or shock during or immediately following surgery in the lower neck should always suggest the possibility of this complication The diagnosis should be confirmed at once by a radiograph or, in an emergency, by needle aspiration of the pleural space Pneumothorax should be treated promptly by underwater drainage through a small catheter

A

Left jugular trunk

Right jugular trunk

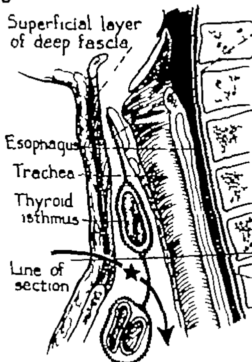
Innominate vein

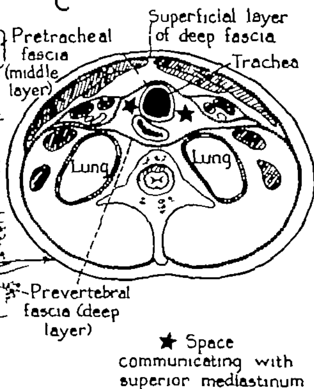
Right subclavian trunk

Left subclavian trunk

Right lymphatic duct

Thoracic duct





Operative Complications

Air Embolism

Opening into the lumen of one of the major veins in the lower neck may result in an embolism to the heart and sudden death if not promptly corrected If the internal jugular vein, for instance, is inadvertently incised, or if a clamp should slip off its lower end following division, air will be sucked into the vein instead of blood spurting out When this occurs, the opening in the vein must be closed promptly by digital pressure or clamping Entrance of small amounts of air may do no harm, large amounts will cause sudden death due to a tampon of foamed blood in the right heart Massive air emboli to the right heart have been successfully treated by needle aspiration of the right ventricle and also by placing the patient in a lateral recumbent position with the left side down, this position alleviates the air trap in the right ventricle, allowing the heart to pump blood effectively

Lymphedema

Rarely following a unilateral radical neck dissection, and much more frequently following a bilateral neck dissection, there will be considerable swelling of the soft tissues of the face and oral cavity At times, the edema is so marked that the patient's appearance becomes alarming, with pronounced swelling of the eyelids and conjunctivae, the lips, and the tongue The edema is not due to removal of the jugular veins, for there remain abundant venous collateral pathways, but is caused by interruption of the main lymphatic ducts of the head and neck Within 3 months following surgery, the edema will almost completely disappear in most patients

Nerve Injury

Most major head and neck procedures necessitate exposure and identification of one or more important motor or sensory nerves These include the 5th, 7th, 9th, 10th, 11th, and 12th cranial nerves and their branches, the cervical and brachial plexuses, and the cervical sympathetic trunk The technics of identification and preservation of these nerves are outlined in the descriptions of

specific operative procedures If an important nerve should be inadvertently severed an immediate attempt at repair should be made The nerve ends must be aligned accurately and approximated without tension using perineural sutures of fine arterial silk.

In the treatment of malignant tumors it is well to realize that any one of the major nerves may be deliberately sacrificed if it is encroached on or invaded by tumor Various degrees of cosmetic or functional loss will result and must be accepted as a price for eradication of the cancer When a segment of nerve must be removed because of gross invasion by tumor it is well to perform as extensive a removal of the nerve as exposure permits since invasion of the perineurium by tumor cells is a common finding and its extent is often not grossly evident

The mandibular branch of the facial nerve is one of the most frequently injured nerves in the upper neck Its division results in weakness of the lower lip due to denervation of the triangularis and quadratus muscles A gradual improvement and recovery of function may appear in the course of 9 to 12 months following this injury apparently through minor anastomosing branches from other divisions of the facial nerve Following operative exposure of the facial nerve paralysis of some or all of the muscles innervated by it may occur even though no portion of the nerve was severed If the surgeon is certain that the nerve and its branches were preserved, he may be confident that recovery will take place If the main trunk of the facial nerve has been severed and anastomosis is impossible the face may be supported by fascial strips inserted through subcutaneous tunnels and anchored to the temporal fascia Fusion of the eyelids near the inner and outer canthi is usually necessary to prevent corneal ulceration (see Radical Parotidectomy Chapter 11)

A variety of changes may follow injury to the laryngeal branches of the vagus nerve Division of the superior laryngeal nerve frequently results in severe physiologic disturbances in the postoperative period There is interference with the normal swallowing mechanism due largely to loss of sensation in the base of the tongue and entrance to the larynx Recovery of normal deglutition usually will occur within 1 month The cricothyroid muscle is supplied by the superior laryngeal nerve and its paralysis will have

only minor effects on the patient's voice A number of clinical pictures may be seen after injury to the recurrent laryngeal nerve, depending on the degree of injury to the nerve and the state of the unparalyzed muscles The involved vocal cord has little motion and tends to lie nearer the midline than its normal or cadaveric position This adduction increases in time but is seldom severe enough to interfere with the airway Bilateral recurrent nerve injury will result in laryngeal obstruction, which is progressive with the passage of time and requires tracheostomy

The accessory nerve is deliberately sacrificed during radical neck dissection and may be accidentally injured in the course of such operations in the upper neck as excision of a branchial cleft cyst The weakness and drooping of the shoulder that results is seldom a severe disability The paralysis of the trapezius muscle is partly compensated for by other muscle groups of the shoulder girdle, and active exercise of the extremity should be encouraged

Tetany

The parathyroid glands are extremely variable in number and position and are difficult to identify at the time of surgery It is often impossible to predict which patients will exhibit signs of hypoparathyroidism following thyroid surgery Tetany often will not appear following a radical total thyroidectomy when no attempt is made to preserve parathyroid tissue, permanent hypoparathyroidism results in less than one quarter of patients subjected to this procedure On the other hand, transient postoperative tetany occasionally appears after a subtotal thyroidectomy in which the posterior capsule of the thyroid and the parathyroid glands are preserved

The earliest symptoms of tetany are numbness and tingling of the hands and feet There is often an associated sensation of constriction in the throat Positive Chvostek and Trousseau signs will confirm the diagnosis at this stage, as will blood chemical examinations revealing a decrease in the serum calcium and an elevated phosphorus If the condition is unrecognized and allowed to progres[illegible] -opedal spasms, generalized muscle spasms, and laryng [illegible] h asphyxia will follow Initial treatment consists of

intravenous administration of calcium gluconate 10-20 cc of a 10% solution This may be repeated several times each day as signs and symptoms recur The patient should receive a high-calcium low phosphorus diet supplemented with calcium lactate 10 Gm daily and large doses of vitamin D Persistent evidence of hypoparathyroidism requires treatment by oral administration of dihydrotachysterol (A T 10) 5-15 mg daily Most cases of postoperative hypoparathyroidism spontaneously recover within 1-5 weeks following surgery Occasionally a patient will require continuous dietary and replacement therapy

Laryngeal Edema

Maintenance of an adequate airway is often the most pressing problem faced in head and neck surgery Any obstructive lesion of the upper respiratory tract threatens life by asphyxia The chink between the vocal cords is the narrowest portion of the upper respiratory tract and the most common site of obstruction Following many major surgical procedures in the suprahyoid region and around the base of the tongue one may expect laryngeal edema and sudden obstruction of the airway to develop Resection of half or more of the mandible may cause obstruction by laryngeal edema or by the tongue falling posteriorly in the pharynx Laryngeal edema also is likely to occur following most operations on the larynx with the exception of minor procedures done through the laryngoscope

Edema of the larynx may appear rapidly in the postoperative period and will at times lead to asphyxia within several minutes *The earliest signs of an impaired airway are usually* apprehension and restlessness in the patient This is followed by an increase in pulse rate and by difficult, labored respirations with inspiratory stridor Cyanosis is a relatively late sign of asphyxia and treatment must begin before this appears

TRACHEOSTOMY

In addition to the surgical causes of obstruction of the upper respiratory tract already mentioned, there are numerous nonoperative causes These include specific laryngeal infections and infec

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allowed to persist Asphyxia in this situation is as inevitable and as serious as that due to obstruction of the larynx Tracheostomy becomes a useful therapeutic measure in patients developing obstruction of the lower respiratory tract who are unable to cough effectively and in whom the usual conservative measures including nasotracheal aspiration and bronchoscopy fail or give only temporary relief In addition to providing a facility for easy aspiration of the tracheobronchial tree tracheostomy allows easier respirations by removing the resistance provided by the vocal cords to breathing and reduces the dead space" existing between the oronasal passages and the pulmonary alveoli Thus the procedure is applicable not only to surgery of the head and neck but is of value in severe injuries of the chest, and in the care of unconscious patients following head trauma or neurosurgical operations It is also occasionally indicated in the care of feeble and debilitated patients who are unable to cough effectively following other operative procedures

A tracheostomy is a simple operation when the patient is completely anesthetized with an endotracheal tube in place Few additional problems will arise when local anesthesia must be used When laryngeal edema appears and tracheostomy must be carried out rapidly as a lifesaving measure it may become an extremely difficult procedure The difficulties are multiplied greatly if a tracheostomy has been performed previously and the trachea is hidden in dense scar tissue Whenever possible, the surgeon should have adequate lighting, a suction apparatus a supply of oxygen, and an assistant to aid in retraction.

In a situation of utmost urgency where a high degree of laryngeal obstruction exists a large gauge needle will serve as a temporary airway until a tracheostomy can be performed. A no 15 needle is used to pierce the cricothyroid membrane or the trachea. The airway thus afforded is adequate for only a limited time and should be replaced by a tracheostomy as soon as feasible

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Tracheostomy

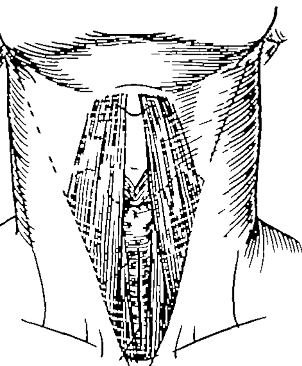
A —The skin in the midline of the lower neck is infiltrated with 1% procaine Generally, skin infiltration alone will suffice and no procaine need be injected in the deeper tissues A 5-cm vertical incision is made in the midline commencing just above the suprasternal notch

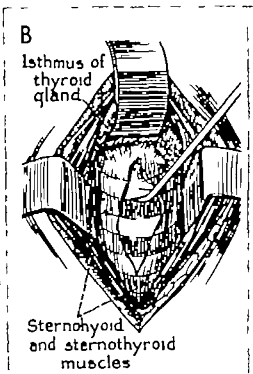
B —The incision is carried through the superficial layer of the deep cervical fascia in the midline between the strap muscles, and the muscles are retracted laterally At this point, the isthmus of the thyroid gland will be noted in the upper half of the wound beneath the strap muscles The isthmus is retracted upward to allow exposure of the trachea rarely it will be necessary to divide a bulky thyroid isthmus in the midline between clamps The trachea is then exposed by blunt dissection of the overlying loose areolar tissue and pretracheal fascia

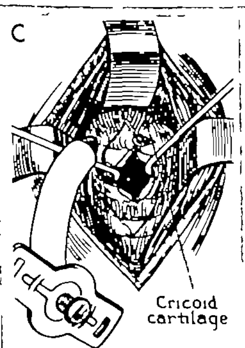
C —Two small hooks (tracheal retractor, sharp prong, 6½ in) are of considerable value in elevating and stabilizing the trachea One hook is used to pierce the trachea and lift it upward in the wound If there is no great need for speed at this point, it is helpful to inject 0 5 cc of 10% cocaine into the lumen of the trachea through a fine hypodermic needle A vertical incision is then made across two tracheal rings as high on the wall of the trachea as possible The second hook is placed in the incision to retract one edge, the first hook is then disengaged from the wall of the trachea and used to retract the opposite edge of the tracheal incision

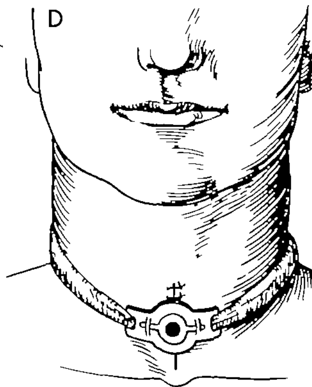
D —A tracheostomy tube with obturator in place is inserted in the trachea A no 6 tube is generally used for adults, a no 2 or no 4 tube for children The obturator is removed and the trachea suctioned with a catheter The wound edges are allowed to fall together around the tube No closure is necessary except for one or two skin sutures above the tube, the lower angle of the wound is left open for drainage The tracheostomy tube is held in place with tapes tied snugly around the neck, and a gauze dressing split around the tube is applied to the wound

The tracheostomy tube may be safely changed after 1 week has elapsed and a tract has formed Before final removal of the tube, it is often wise to occlude it with a small cork for 24 hours to determine whether the laryngeal airway is adequate


Incision


B
Isthmus of thyroid gland
Sternohyoid and sternothyroid muscles


C
Cricoid cartilage


D

] **Tracheostomy**

A—The skin in the midline of the lower neck is infiltrated with 1% procaine Generally, skin infiltration alone will suffice and no procaine need be injected in the deeper tissues A 5-cm vertical incision is made in the midline commencing just above the suprasternal notch

B—The incision is carried through the superficial layer of the deep cervical fascia in the midline between the strap muscles, and the muscles are retracted laterally At this point, the isthmus of the thyroid gland will be noted in the upper half of the wound beneath the strap muscles The isthmus is retracted upward to allow exposure of the trachea, rarely it will be necessary to divide a bulky thyroid isthmus in the midline between clamps The trachea is then exposed by blunt dissection of the overlying loose areolar tissue and pretracheal fascia

C—Two small hooks (tracheal retractor, sharp prong, 6½ in) are of considerable value in elevating and stabilizing the trachea One hook is used to pierce the trachea and lift it upward in the wound If there is no great need for speed at this point, it is helpful to inject 0 5 cc of 10% cocaine into the lumen of the trachea through a fine hypodermic needle A vertical incision is then made across two tracheal rings as high on the wall of the trachea as possible The second hook is placed in the incision to retract one edge, the first hook is then disengaged from the wall of the trachea and used to retract the opposite edge of the tracheal incision

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The tracheostomy tube may be safely changed after 1 week has elapsed and a tract has formed Before final removal of the tube, it is often wise to occlude it with a small cork for 24 hours to determine whether the laryngeal airway is adequate

priate or improper primary treatment will make satisfactory reconstructive procedures difficult, prolonged or impossible

EMERGENCY CARE

In the early management of the injured patient hemorrhage and respiratory impairment constitute acute emergencies and demand immediate attention In most instances external hemorrhage may be controlled by dressings and direct pressure over the wound until adequate exposure for suture or ligation can be obtained Common carotid artery compression for the control of hemorrhage from the branches of the external carotid artery should not be practiced The procedure is unsafe and is seldom effective in stopping the bleeding Immediate application of hemostats to bleeding vessels may be necessary before preparations for definitive treatment have been started While hemorrhage is usually obvious respiratory failure may be more insidious and it is often overlooked until the patient is in critical condition Three factors may lead to respiratory difficulty obstruction of the airway impairment of the bellows action of the thorax and diaphragm, and loss of the normal negative pressure in the intrapleural space The surgeon should ascertain the adequacy of respiration in every seriously injured patient. If there is impairment, no time should be lost in application of appropriate emergency measures Obstruction of the airway requires immediate removal of any foreign bodies blood, or mucus present in the throat The patient should be placed in the lateral or face-down position to prevent the accumulation of more blood and mucus in the mouth and pharynx. The tongue must be held forward either by the position of the head, an oral airway or by traction on a safety pin inserted through its tip At times tracheostomy is necessary to provide an adequate airway and should be performed without delay A tracheostomy is also of value when respiratory motion of the thorax is impaired or paradoxical When accompanied by adequate splinting of the injured chest, considerable improvement in respiration will occur Intrapleural blood or air interfering with normal breathing should be removed by needle aspiration or tube thoracostomy

Shock is not frequent in uncomplicated head and face injuries

CHAPTER 5

Traumatic Lesions of the Head and Neck

TRAUMATIC LESIONS of the head occur in a high percentage of accidents In a study made by the Automobile Crash Injury Research Group of Cornell University of the types and locations of injuries incurred in automobile accidents, it was found that 73% involved the head or face and 7% occurred in the neck A survey of accident ward admissions, by Robert W Zollinger*, showed that 42% of the patients suffered head injuries Since there are approximately 10,000,000 accidental injuries each year in the United States, the number of patients with head, face, and neck lesions requiring treatment is tremendous Usually it is the general surgeon who is first called on to treat this vast army of injured Primary treatment may be lifesaving when the situation calls for such emergency procedures as control of hemorrhage, release of extradural hematoma, or tracheostomy It can be definitive, and it is preferable that it should be, when it deals with open facial wounds and facial fractures, for there are few regions where correct primary treatment is o important Dependent on it may be the preservation of such important functions as maintenance of features, visual acuity, respiratory ease, mastication, and facial expression Intelligent primary application of principles demonstrated so well to be of importance in war and civilian practice will often make late reconstructive work unnecessary Inappro-

* Zollinger, R W Traffic injuries, a surgical problem, A M A Arch Surg 70 694, May, 1955

head and neck wounds occasionally must be deferred for the care of some more serious injury elsewhere. The determination of priority for treatment of the individual injuries in the patient is pre-eminently a matter of good clinical judgment and common sense. While lists of injuries arranged in order of importance and need for immediate treatment may be helpful at times, good judgment will usually determine which problem should be considered first. Certainly hemorrhage and impaired respiration demand immediate attention, as does the treatment of shock. An expanding intracranial lesion such as an extradural hematoma also demands priority.

On occasion, treatment of two closely associated lesions may be combined, such as elevation of a depressed skull fracture and reduction and fixation of a midfacial fracture. In the critically injured patient, however, only those operative procedures considered vitally necessary should be performed. Treatment of many traumatic lesions of the head and neck may be safely postponed if the patient's condition or the presence of more serious injuries makes this necessary. Traumatized bones and soft tissues should be stabilized by a bulky compress of sterile gauze applied to the wounded area and held by a Barton type bandage wrapped around the head and jaws. Advances in antibiotic therapy have permitted safe closure of some open wounds of the face by primary suture as long as 24 hours after the injury. During this period of delay a plastic or rubber pharyngeal airway is often useful in maxillofacial wounds. This aids in holding the tongue forward and in aspiration of pooled pharyngeal secretions.

Because these patients have wounds of many systems, it is frequently necessary to obtain help or consultation from surgeons with special training or interest in the fields of neurosurgery, orthopedic surgery, urology, and ophthalmology. However, unless there is one person responsible for the entire diagnostic and treatment problem, serious errors can be made. It is essential that one man alone be responsible for writing orders and deciding on priority of treatment. Medication of value for the treatment of one injury may be incompatible with another. Surgical treatment or anesthesia definitely indicated for one lesion may be harmful for others. A co-ordinator of the whole is needed. Once he assumes command

However, if hemorrhage has been prolonged or there are associated traumatic lesions, shock may be severe and require emergency treatment Adequate circulating blood volume should be restored by the administration of blood or plasma expanders

In the early care of a victim of an automobile accident, attention should not be focused on injuries of the head and neck alone More frequently than ever before, we are confronted by patients presenting a combination of wounds intracranial, facial, thoracic, abdominal, and extremity The problems cannot be solved simply by applying the best methods of treatment to each injury The combination of injuries creates special problems Diagnosis is more difficult, and serious injury may be completely masked At times, treatment of some injuries must be deferred or modified in the total management of the patient

Accurate diagnosis is always a greater problem when multiple injuries are present The danger of overlooking a hidden injury is quite real There is a tendency to concentrate on the obvious and most dramatic and appalling wound or fracture, thus forgetting to look for the hidden lesion Centering attention on severe open facial fractures may lead one to overlook more lethal injuries such as a ruptured spleen or perforated intra-abdominal viscus Concentration on the obvious head injury in the unconscious patient may result in neglect of an equally dangerous thoracic wound

To avoid these pitfalls, a complete physical examination of the injured patient is important The physician frequently cannot proceed in the routine, standardized manner He is often forced to apply immediate resuscitative and therapeutic measures before any history or detailed examination is possible At some time early in the treatment, however, a complete physical examination with the patient disrobed is required Every diagnostic aid must be available and be used At times, repeated examinations are necessary over the first 12-24 hours following injury, with careful evaluation of changes in signs and symptoms which may point to an intra-abdominal or intracranial injury The physician must be alert, however, to the danger of repeatedly moving seriously injured and shocked patients for diagnostic purposes

Following complete evaluation of all injuries present, a decision must be reached regarding priority for treatment Treatment of

in this area than in other sites The closure should be in layers with meticulous approximation of divided tissue Much depends on skin closure for if it fails infection is probable and the final result uncertain.

Wounds with extensive loss of substance require further maneuvers to achieve the principle of primary closure When the defect is in the skin and subcutaneous tissues alone relaxing incisions and the rotation of adjacent flaps may be useful (see Chapter 6) At times a split skin graft must be used for coverage of the primary skin defect or the site of a rotation flap When the wound consists of a full thickness defect of skin, subcutaneous tissue muscle and mucosa preventing any primary reconstruction, the mucous membrane is sutured directly to the skin around the edges of the defect This provides a clean wound which will heal per primam and allow early institution of reconstructive procedures without the delay caused by infection

Except for small wounds bulky dressings of sterile mechanic s waste are applied and held snugly in place A combination of penicillin and streptomycin should be given postoperatively in addition, tetanus antitoxin or toxoid should be given every patient

Major injuries to the eyes may occur concomitantly with severe facial trauma and they require highly specialized treatment. Application of appropriate first aid measures makes it possible for the ophthalmologist to save many eyes that otherwise would be lost The injured eye should be irrigated with large quantities of sterile saline solution and all loose foreign bodies washed away It is inadvisable to instill anesthetic ointments or solutions since they impair corneal healing Pain is controlled by codeine or morphine Antibiotics should not be used locally but should be given systemically The globe should be protected This can be accomplished by closing the lids over the eye by suturing the lid margins together Protection from the squeezing action of the lids on the globe should be obtained in all severe eye injuries by procaine injection of the 7th nerve Three cubic centimeters of procaine solution is injected in front of the tragus of the ear into the parotid gland blocking the temporozygomatic division of the nerve A head bandage is applied to hold the lids gently closed. If the patient is to be transported, he should be recumbent.

everyone else on the team—attending physicians, house staff, and nurses—should know that all orders and all treatment will be coordinated through him

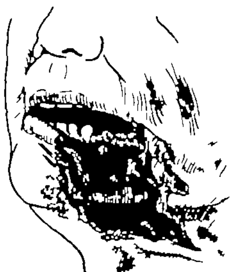
SOFT TISSUE WOUNDS OF THE FACE AND SCALP

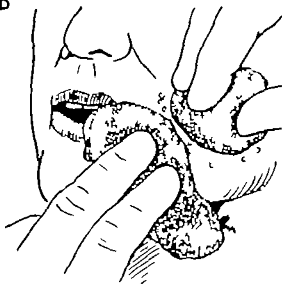
These wounds constitute a large proportion of head and neck injuries An infinite variety are seen, varying from simple, clean lacerations to ragged, traumatized wounds grossly contaminated with dirt and foreign bodies, and wounds with extensive loss of tissue Each wound must be carefully evaluated before definitive treatment is undertaken The mode of injury and the elapsed time should be ascertained Roentgenograms are frequently necessary to detect bony injury or the position of foreign bodies Damage to important nerves and salivary ducts must be considered and detected, if possible However, exploration or probing of the wound in an attempt to determine the extent of injury should not be done until formal wound care is begun

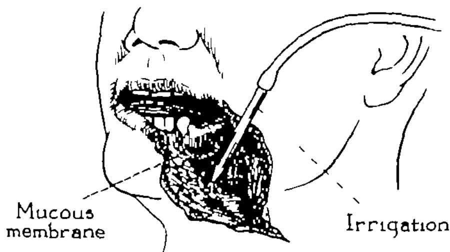
The principles of wound care in this region differ in some important respects from management of wounds elsewhere in the body In the first place, there must be a most miserly conservation of all wounded tissue, including mucous membrane, bone, muscle, subcutaneous tissue, and skin Such conservation must in no way lessen adequate cleansing and exploration of the wound But, in the face, no tissue that is viable, no matter how contused, torn, or dirty, should be sacrificed Debridement of these wounds consists mainly of mechanical cleansing No chemical antiseptic in or around the wound is necessary or desirable The wound should be thoroughly explored and irrigated with saline solution, washing out all particles of gravel, wood and glass splinters, and completely nonviable tissue Bleeding vessels are ligated and complete hemostasis obtained

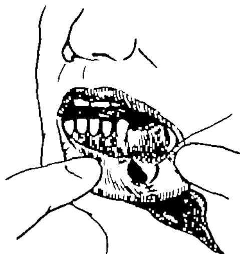
In contrast to traumatic wounds of the extremities, an attempt should be made to obtain primary closure in facial wounds This can be successful only when thorough cleansing has converted the contaminated wound to a clean one The presence of a rich blood supply to the scalp and face and the absence of deep muscle compartments allow primary closure to be performed with more safety

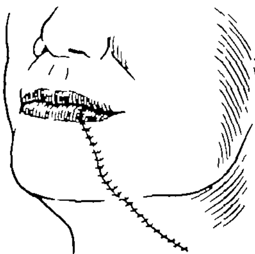
PLATE 14











Repair of Facial Laceration

A—The surgical treatment of soft tissue wounds of the face should be considered as definite a surgical operation as the repair of a hernia or an appendectomy The operation consists of several steps which should be carried out in an orderly manner with meticulous attention to detail Depending on the extent and location of the wound, surgery may be performed with local infiltration, regional block, or general endotracheal anesthesia

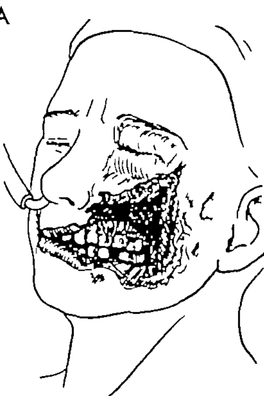
B—*Skin cleansing* A pack of sterile gauze is placed over the laceration and the surrounding skin is thoroughly cleansed Cotton, gauze, or a soft brush immersed in warm water with a mild detergent should be used with as much thoroughness as the surgeon takes in scrubbing his hands The object of this procedure is to remove all grease, dirt, or traumatic debris and to render the skin as sterile as possible Small bits of dirt or powder embedded in the skin require thorough scrubbing for their removal, to prevent "tattooing"

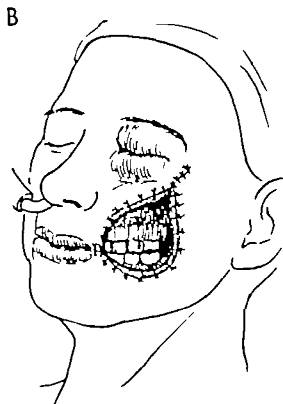
C—*Wound cleansing* The gauze is removed from the wound, gloves are changed, and the area draped with sterile towels A generous quantity of saline solution is used to flush all loose foreign bodies from the wound Those remaining may be extracted with a forceps or hemostat A mild detergent may be required to remove oil or grease Every fragment of viable tissue is preserved No skin is sacrificed, loose fragments of subcutaneous tissue or muscle are sparingly removed and all other tissues simply cleansed and allowed to remain A final inspection is made and all bleeding points ligated with fine chromic catgut or fine white cotton No antiseptic or antibiotic preparation is placed in the wound

D—*Wound closure* The wound is closed in layers, using extreme care to approximate accurately points that belong together The mucous membrane of the oral cavity is closed with fine silk A minimal number of fine chromic sutures are used to approximate the muscle and subcutaneous tissue The dermis is approximated to relieve tension on the skin edges

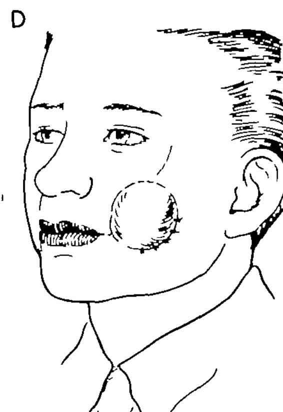
E—Interrupted sutures of 4-0 or 5-0 silk placed close together and close to the wound edges are used to close the skin No drains are used Dressings may be omitted for small wounds, but are required for more extensive ones

PLATE 15









Wound with Full-Thickness Defect

A —In facial wounds with extensive loss of substance, immediate repair and reconstruction is often impossible Much time can be saved and additional deformity can be avoided if such wounds are managed in a manner that permits primary healing Infection will develop in these wounds, with resultant scarring and delayed healing, if traumatized bone, muscle, or subcutaneous tissue is allowed to remain exposed

Endotracheal anesthesia is generally necessary A sterile gauze pack is placed in the wound and the surrounding skin prepared as described previously for a facial laceration The gauze pack is removed, gloves are changed, and the area is draped with sterile towels Careful cleansing of all depths and crevices of the wound is then carried out, using copious amounts of saline solution No skin is sacrificed Ragged devitalized fragments of mucosa, muscle, and subcutaneous tissue are excised Bone fragments, even when completely detached, are cleansed and replaced in proper position

B —A closed surgical wound is then obtained by approximating the mucous membrane of the oral cavity to the skin around the edges of the tissue defect Interrupted sutures of fine silk are used Portions of the wound which may be closed in layers without tension are repaired as described for a facial laceration The mucosa-to-skin repair around the defect should heal promptly without infection

C —Secondary reconstruction of the remaining defect must be carried out with a tubed pedicle flap as described in Chapter 6 The skin tube may be constructed in the cervical or the acromiothoracic region The end of the tube is lined with a split-thickness skin graft to replace the mucous membrane of the oral cavity and is migrated into the defect

D —At a later stage, the remaining tube is removed or replaced in its original site

performed without delay Should there be a loss of substance of the vessel making anastomosis impossible the insertion of an arterial homograft an autogenous vein graft or a vascular prosthesis must be attempted Ligation should be used only as a last resort In the management of injuries of the jugular vein ligation is preferable to suture Untreated vascular wounds in the neck may lead to the development of arterial hematoma arterial aneurysm and arteriovenous fistula These lesions occur typically in the carotid vessels but any moderate sized vessel including the vertebral artery may be involved

Injuries of the pharynx and cervical esophagus may be caused by endoscopic examination, foreign bodies or external trauma While perforations due to endoscopic accidents occur typically in the posterior hypopharynx just above the cricopharyngeus muscle, perforations due to external trauma such as knife or bullet wounds may occur at any level in the neck Early symptoms of perforation include dysphagia, tenderness and swelling on either side of the larynx or trachea Cervical emphysema is present and crepitation is noted on palpation Roentgenograms may disclose air in tissue planes in the neck Later symptoms are those due to sepsis in the visceral space of the neck or the superior mediastinum Repair of such lacerations requires exposure of the hypopharynx and cervical esophagus (see Chapter 15) The laceration is closed with interrupted sutures of fine silk and a drain inserted in the area but not to the point of perforation. The cervical wound is left open to be closed later by secondary suture Tube feedings are required for 7 10 days

[Treatment of soft tissue wounds of the neck *on page 84*]

SOFT TISSUE WOUNDS OF THE NECK

Neck wounds do not occur as frequently as those of the scalp and face but they too have special characteristics which require understanding and appropriate treatment. Significant vascular lesions are more frequent and control of major hemorrhage is often a problem. Infection is also a far more serious complication of wounds in this region and this threat dictates management considerably different from that used for wounds of the face.

Traumatic wounds of the neck require complete excision of all devitalized tissues. This is particularly true of lacerated and avascular portions of muscle. Frequently the wound in the skin must be extended to allow adequate exposure and debridement of the traumatized deeper tissues as well as identification and protection of important structures. It is often advisable after debridement of deep cervical wounds to leave them open and unsutured. Secondary closure should follow in 5-7 days. All puncture wounds involving the floor of the mouth or extending deeply into muscle bellies should also be left open. In more superficial wounds with little traumatized tissue primary closure may be safe, but even these wounds should be drained for 24-48 hours.

Maintenance of a clear airway is imperative in wounds of the neck. Obstruction may be caused by increasing pressure within the neck from concealed hemorrhage or by edema of the larynx or trachea following contusion, laceration, or crushing injury. Because of slowly developing edema and tissue reaction around the glottis, an airway which seems adequate at first may become obstructed hours after the injury. Development of deep cervical infection may also cause obstruction. A temporary tracheostomy should be performed whenever there is any doubt regarding the adequacy of the airway.

In the management of hemorrhage, any vessel in the neck may be ligated safely, with the exception of the common and internal carotid arteries. Occlusion of these vessels should be avoided whenever possible, since it is accompanied in about one fourth of cases by neurologic complications which are serious and which may be fatal (see Chapter 4). Wounds of the common or internal carotid must be exposed and primary suture or end-to-end anastomosis

performed without delay. Should there be a loss of substance of the vessel, making anastomosis impossible, the insertion of an arterial homograft, an autogenous vein graft, or a vascular prosthesis must be attempted. Ligation should be used only as a last resort. In the management of injuries of the jugular vein, ligation is preferable to suture. Untreated vascular wounds in the neck may lead to the development of arterial hematoma, arterial aneurysm, and arteriovenous fistula. These lesions occur typically in the carotid vessels, but any moderate-sized vessel, including the vertebral artery, may be involved.

Injuries of the pharynx and cervical esophagus may be caused by endoscopic examination, foreign bodies, or external trauma. While perforations due to endoscopic accidents occur typically in the posterior hypopharynx just above the cricopharyngeus muscle, perforations due to external trauma such as knife or bullet wounds may occur at any level in the neck. Early symptoms of perforation include dysphagia, tenderness, and swelling on either side of the larynx or trachea. Cervical emphysema is present and crepitation is noted on palpation. Roentgenograms may disclose air in tissue planes in the neck. Later symptoms are those due to sepsis in the visceral space of the neck or the superior mediastinum. Repair of such lacerations requires exposure of the hypopharynx and cervical esophagus (see Chapter 15). The laceration is closed with interrupted sutures of fine silk and a drain inserted in the area but not to the point of perforation. The cervical wound is left open to be closed later by secondary suture. Tube feedings are required for 7-10 days.

[Treatment of soft tissue wounds of the neck *on page 84*.]

Treatment of Soft Tissue Wounds of the Neck

Traumatic wounds of the neck with laceration of large muscle masses such as the trapezius or occipital triangle muscle group, should not be closed primarily. Sharp contrast must be drawn between the treatment of such wounds and those of the face. Extensive civilian and military experience has demonstrated the inadvisability of treating these wounds in a similar manner. While primary closure is a virtue in wounds of the face, it is an extremely questionable procedure for deep neck wounds.

A—The first steps in treatment, namely skin cleansing, are identical with those outlined in treatment of wounds of the face.

B—Emphasis must be placed on preserving as much skin as possible. However, all shredded and devitalized fascia, subcutaneous tissue, and fat are removed by sharp dissection. Aid in this step is obtained by dissecting under constant saline irrigation, the fluid floating the traumatized tissue away from surrounding viable tissue. The next step in debridement is probably the most important and concerns removal of traumatized and avascular muscle. Dead avascular muscle left in the wound is the most important factor in the development of subsequent anaerobic infection. It is of prime importance to remove this muscle to prevent infection. Muscle that does not bleed when incised should be excised to a point where bleeding occurs. Muscle that will not contract when pinched with a forceps is probably too severely traumatized to leave in the wound.

C—The wound is left open and packed loosely with petrolatum gauze. Primary nonsuture of traumatic wounds of this type is the most vital of all principles of contaminated wound care.

D—Early closure of the wound is accomplished by secondary suture. The technic of closure involves undermining the skin edges with approximation without tension. At times, due to various factors, suppuration occurs in these wounds and secondary closure necessarily may be delayed. However, with vigorous treatment, there are few traumatic wounds, even those which suppurate, which cannot be closed within a few weeks.


A
B
C
D
Secondary closure
Debridement completed - ready for packing

The success and safety of this procedure depend on adherence to many of the principles of vascular surgery. Wide exposure is mandatory. Proximal and distal control of the artery must be obtained even if this requires additional exposure and prolonged dissection. After securing control, the artery must be completely freed within its sheath for several centimeters on either side of the lesion. Fine silk or cotton suture material is used.

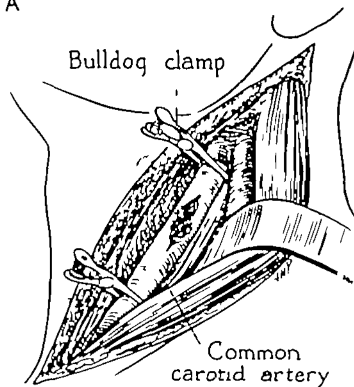
A.—The incision extends along the anterior border of the sternocleidomastoid muscle from the mastoid tip to the sternal notch. The sternocleidomastoid muscle is retracted outward and may be divided in order to obtain maximal exposure of the carotid sheath. The sheath is opened and the common carotid artery is freed on either side of the laceration and controlling tapes or bulldog clamps placed around it both proximal and distal to the laceration. Should hemorrhage recur at any time during the procedure because of dislodgment of the thrombus temporarily closing the laceration, direct finger or sponge stick pressure over the laceration must be maintained until the controlling clamps or tapes are placed and tightened.

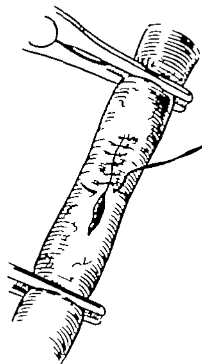
B.—The segment of artery containing the laceration is completely freed from the surrounding tissue. The controlled segment of artery is thoroughly irrigated with heparin solution (10 mg to 100 cc of isotonic saline) to remove all blood clots and fibrin debris. The laceration is now closed, using interrupted sutures of 5-0 arterial silk. Should simple longitudinal or transverse closure be impossible because of a large, jagged laceration with contused edges, the area must be resected and one of the two following technics used to restore continuity.

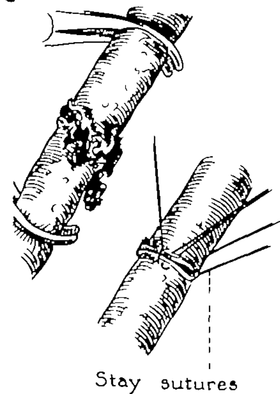
C.—End-to-end anastomosis. Three fine stay sutures are placed equidistant through the ends of the arteries, dividing the circumference into equal segments. Continuous or interrupted sutures of arterial silk close each segment.

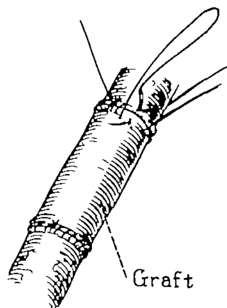
D.—Should loss of arterial length be so great as to preclude end-to-end suture, the gap may be bridged by an arterial homograft, venous autograft, or vascular prosthesis. The length of time during which the carotid may be occluded without irreversible cerebral damage is variable. Complete occlusion of the vessel should be maintained for the minimal time possible.

PLATE 17


A
Bulldog clamp
Common
carotid artery


B


C
Stay sutures


D
Graft

Treatment of Laceration of the Common Carotid Artery

The success and safety of this procedure depend on adherence to many of the principles of vascular surgery Wide exposure is mandatory Proximal and distal control of the artery must be obtained even if this requires additional exposure and prolonged dissection After securing control, the artery must be completely freed within its sheath for several centimeters on either side of the lesion Fine silk or cotton suture material is used

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nasal septum is broken and displaced The base of the nose is flat broad, and depressed and the tip elevated and deviated In fractures resulting from a lateral blow one nasal bone together with the nasal process of the maxilla is driven inward and the opposite side of the nose is forced outward thus creating the bent nose type of deformity More complicated fractures of the nasal bones result when continued frontal force is not dissipated on the nasal bridge The nasal fracture is then part of a mid face fracture with the fracture line extending across the orbit and maxilla or into the cribriform plate

The *diagnosis* of fracture of the nasal bones is best made by careful examination with little reliance placed on x ray films Before swelling occurs typical deformities may be seen and felt, and careful palpation may elicit crepitation Examination of the nasal passages after application of topical anesthesia if necessary may show a tear in the mucous membrane or a deviation of the septum.

Reduction of nasal fractures should be accomplished as soon as possible after injury Simple fractures can be realigned with a narrow rubber-covered periosteal elevator or hemostat within the nostril, aided by the thumb and forefinger outside The displaced nasal walls are elevated and molded into position More complicated fractures may require disimpaction of the nasal bones and frontal processes of the maxillas Attention must always be directed to the correction of any deviation of the bony and cartilaginous nasal septum

Fractures of the Mandible

The mandible is more directly exposed to trauma than the other bones of the face While fractures may occur anywhere in the mandible, there are certain typical locations where they are found Fractures of the body in the region of the molar teeth or near the mental foramen are common, and if bilateral, the lines tend to extend through both mental foramina. A fracture of the body is often associated with a fracture of the opposite condyle Condylar fractures may be bilateral and occasionally the ascending ramus or coronoid process is broken The displacement of the fragments

BONY INJURIES OF THE FACE AND JAWS

Fractures of the bones of the face have several unique characteristics wherein they differ from fractures in other locations Because of their exposed position and minimal soft part protection, almost any severe trauma to the face results in fracture When displacement occurs, with the exception of mandibular fractures, it is due to the force causing the fracture and not to muscle pull In addition, fracture of a single bone is uncommon Combination of facial fractures is the rule in severe trauma

These characteristics of facial fractures should be considered when examining and treating patients with facial injuries Severe soft-part laceration or contusion should cause suspicion that an underlying fracture is present and care must be taken to prove or disprove its existence Recognition and reduction of these fractures during primary wound treatment is important, and the opportunity for satisfactory alignment and fixation will be best at that time

Absence of muscle pull as a factor in the displacement of many facial fractures simplifies reduction Once reduced, these fractures will often remain in position when given simple protection, and elaborate apparatus for traction and fixation is seldom required In severely comminuted open facial fractures, it is necessary to preserve every bone fragment to obtain a stable reduction Under no circumstances should any bone be sacrificed Even those fragments completely separated and lying loosely in the wound should be restored to proper position The importance of accurate reduction cannot be too strongly emphasized Depending on it may be preservation of visual acuity, adequate upper air passages, and effective mastication In addition, the return of normal facial contour and the avoidance of disfigurement requires anatomic reduction

Fractures of the Nasal Bones

These are the most frequent facial fractures and result from a frontal blow on the nasal bridge, or one applied from either side In fractures resulting from a frontal force, the nasal bones and the nasal processes of the maxillas are comminuted and driven backward, often into the ethmoid cells The bony and cartilaginous

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following fracture depends on the pull of the muscles of mastication but is often modified by the position and direction of the fracture line The posterior fragment in fractures of the body near the angle is pulled upward by the masseter and rotated inward by the pterygoids when the fracture line extends upward and backward When the line extends forward, impaction takes place and no displacement is possible In bilateral fractures through the mental foramina, the pull of the geniohyoid and genioglossus muscles results in posterior displacement of the central section The broken condyle is usually displaced medially and rotated around its vertical axis by the pull of the external pterygoid muscle

The diagnosis of mandibular fracture is made by noting points of abnormal mobility, areas of marked tenderness and hemorrhage, and loss of normal dental occlusion Roentgenograms of both hemimandibles with views of the bodies, symphysis, and condyles should be taken

The requirements of first aid treatment of mandibular fractures are to support the jaw and to provide an adequate airway A simple Barton bandage of elastic material will hold the jaw upward and forward and will add greatly to the comfort of the patient during transportation or while awaiting fixation The upper air passages must be cleared of mucus and blood and if the tongue tends to fall back it should be held forward by a transfixion suture

Definitive fixation of the fragments after reduction is most simply obtained by wiring the teeth of the upper jaw to the teeth of the lower jaw This may be accomplished by interdental eyelet wiring or by the single-wire, multiple-loop technic Upper and lower arch bars ligated to the teeth and then wired together afford useful fixation when healthy teeth are available Immobilization of fractures in edentulous jaws can be obtained by several methods The most direct, although technically difficult, is that of Brown where Kirschner wires are passed through the fragments across the fracture site Another useful procedure is to fix a splint on the mandible by passing circumferential wires around it Occasionally, open reduction and internal fixation of fragments by wiring may be indicated Antibiotic therapy should be used in most mandibular fractures, because the fracture line usually communicates with the oral cavity

Fractures of the Zygoma

Fractures of this bone are quite common and are frequently overlooked because early edema obliterates the deformity The lines of fracture typically cross the sutures between the zygomatic bone and the maxilla the frontal bone, and the temporal bone, thus separating the intact zygoma from its neighbors Displacement is downward backward, and inward against the underlying maxilla In simple fractures only slight damage to the maxilla occurs However in more severe injuries the zygoma is driven into the maxillary antrum causing extensive comminution of its anterior wall and the floor of the orbit. The antrum becomes filled with blood and the eye drops downward resulting in diplopia When the zygomatic arch is displaced against the coronoid process of the mandible the patient will be unable to open his mouth fully

Many signs are present to aid in the diagnosis Within the first few hours following the fracture or much later when swelling has subsided, there is flattening of the infra-orbital region and the cheek Ecchymosis of the lids and subconjunctival hemorrhage are often present. Careful observation of patients with severe fractures will reveal downward displacement of the globe on the side of the fracture Palpation around the entire orbital rim may disclose a notch near the frontal suture and on the inferior margin The patient may complain of numbness of the upper lip and gum and be unable to open his mouth Roentgenograms are of great value because the entire zygomatic bone can be visualized It is important to note irregularity of the infra-orbital margin and displacement of the zygomatic arch In severe fractures comminution of the orbital floor and antral walls are seen together with antral clouding

Simple depressed fractures of the zygoma without comminution of the maxilla can be elevated into position with the use of a towel, clip or bone hook. Alignment may also be obtained through the temporal approach of Gillies by inserting a flat instrument between the temporal muscle and fascia. Fractures with extensive comminution of the anterior wall of the maxilla and the orbital floor require reduction from within the antrum After reduction, it

may be necessary to uphold the fragments of the orbital floor with a gauze pack placed in the antrum Occasionally, fractures of the zygomatic-frontal suture and the inferior orbital margin require direct wiring of the fragments which can be accomplished through small incisions made over the fracture sites Careful early alignment of these fractures will ensure an excellent cosmetic result

Mid-Face Fractures

These complicated fractures illustrate the statement that many bones are involved in severe facial fractures Not only are both sides of the face usually affected, but the fracture lines may extend through the nasal bones, maxillas, vomers, pterygoids, palate, ethmoids, zygomatic bones, and frontal bone Cerebral injury may occur and diplopia, respiratory obstruction, malocclusion, and severe facial deformities are common The simplest fracture of this group is one in which the fracture line extends transversely across the maxillas immediately above the alveolus (Guérin's fracture) The entire alveolus is detached and, if not impacted, floats free, suspended only by the soft parts around it There is lateral, backward, or upward displacement and the fragment may be rotated on its vertical axis

When the mid-face is struck at a higher level, its central portion is detached near the nasofrontal suture The fracture line extends across the nasal bones, inner orbital wall, anterior surface of the maxillas, and pterygoid laminae, separating the nose and upper jaw from surrounding parts of the face This detached pyramidal section of the face is wedged firmly between the outer facial bones as it is driven backward and upward

Higher application of the traumatic force to the face causes separation of the mid-face above the zygomatic bones The fracture line extends across the nasofrontal suture and into the cribriform plate with possible tear of the dura, resulting in cerebrospinal rhinorrhea It continues across the inner walls of the orbit, opening the ethmoid cells to infection The fracture extends through the lateral orbital walls and then separates the zygomatic bones from the frontal bone Behind, the line cuts across the posterior surface of the maxilla near the palatine fossa and through the pterygoid

laminae. This extensive fracture results in separation of the entire central portion of the face from the cranium

The diagnosis of mid face fractures is made by observation of the face before swelling ensues, careful palpation and appropriate roentgenograms The face may be shortened giving the "bulldog" appearance or lengthened into the "horse face" while flattening of the upper lip and nose gives a "dish face" appearance Loss of normal occlusion is seen in Guérin s fracture when the upper teeth are overlapped by the lower and in the higher fracture where there is an anterior open bite Abnormal mobility is found when impaction has not occurred and the alveolus or the entire face can be moved forward and backward as well as up and down Palpation of the orbital borders may reveal disruption and the nasal passages are often blocked by collapse of the nasal bones and displacement of the septum Important signs are numbness of the gum and upper lip and diplopia Roentgenograms should be taken in the Water s basal and lateral positions Many of the lines of fracture may be seen, and paranasal sinus opacity demonstrated Complete x ray films of the skull should be included because of the high incidence of associated cranial injury

Bilateral upper alveolar fractures are easily reduced by simple alignment of the upper and lower teeth Reduction of impacted fractures through higher levels of the face may require considerable force. It is often advisable to align the displaced zygomatic bones before the mid face mass is manipulated The principle of suspending the realigned mass to the next higher bone has obviated the use of cumbersome plaster head caps and complicated apparatus Direct wiring of loose fragments is also helpful The use of Kirschner wires (Brown) aids in stabilization Soft part contusion and laceration almost always accompany these extensive facial fractures and require careful treatment Tracheostomy is often necessary It should never be omitted when inter-dental wiring is used in the fixation of mid face fractures

Fractures of the Nose

A —The framework of the nose consists of two nasal bones, the nasal processes of the maxillas, the lateral and alar cartilages, and the bony cartilaginous septum When the nose is struck by a direct frontal blow, both nasal bones are fractured, displaced outward, and depressed backward into the ethmoid cells The bony and cartilaginous septum is broken and markedly deviated and the lateral cartilages often displaced

Early reduction should be performed under topical anesthesia Cotton applicators soaked in 10% cocaine hydrochloride solution are placed in the nasal cavity and allowed to remain for 15 minutes

B —Technic of reduction A rubber-covered narrow periosteal elevator or other flat instrument is inserted into the nostril, and the nasal bones elevated from their depressed location

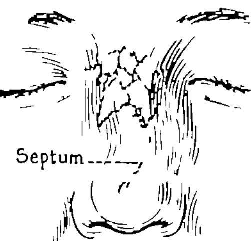
C —The nasal bones are now molded into their former positions with the side of the thumb and forefinger externally and the elevator within the nostril It is important to re-establish the normal airway during this procedure and this will require anatomic reduction of the nasal bones as well as straightening of the nasal septum

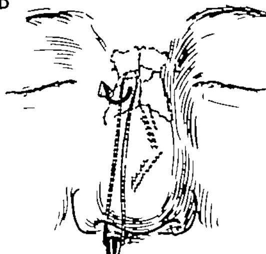
D —The displaced nasal septum is reduced by grasping it with an Asch septal forceps or a rubber-covered straight hemostat At times, it may be necessary to manipulate the cartilaginous part of the septum back into its groove in the vomer The septum should be straight and lie in the midline of the nasal cavity when accurately reduced

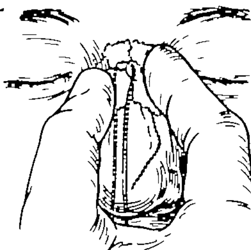
E —The nasal passages are now packed loosely with petrolatum gauze and an external plastic or aluminum splint molded to the contours of the nose is applied and held in place with adhesive tape

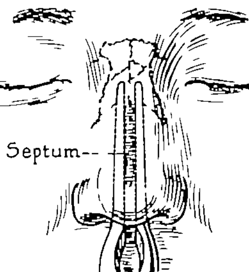
F —Should the reduction be unstable, a mattress suture of steel wire can be placed beneath both nasal bones and through the septum and tied over a gauze pad or metal plate

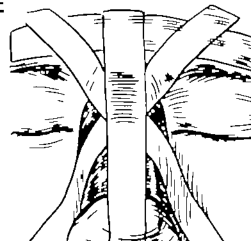
PLATE 18

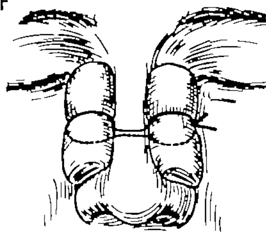












Fractures of the Mandible

Fixation of most mandibular fractures in patients with intact teeth can be attained by the use of interdental wiring The wires may be applied without anesthesia but mandibular nerve block (see Anesthesia, Chapter 3) and procaine injection into the fracture site is preferred

A —Stainless steel wire, size no 24 or 26, is laid along the outer (buccal) surface of the teeth The long end of the wire is passed around the first tooth to be included which is usually the second molar and then through the space between it and the next tooth

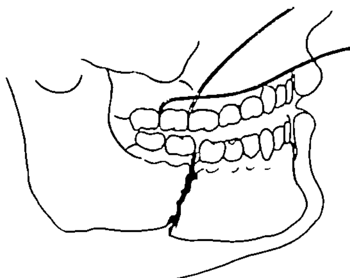
B —The wire is now passed under and then over the part of the wire first placed along the outer surface, thus forming a loop The end of the wire is now passed back through the space between the teeth and around the next tooth This procedure is continued until the cuspid tooth is reached Here the two ends of the wire are twisted together Similar dental wiring is placed on both sides of the upper and lower jaws

C —The loops are now twisted to tighten the wire around the teeth and are bent downward on the lower jaw and upward on the upper jaw Rubber bands are then placed between the upper and lower loops, holding the jaws together and maintaining reduction of the fracture Drainage is generally not required in mandibular fractures Antibiotics are used in all patients Nutrition is maintained by liquid feedings

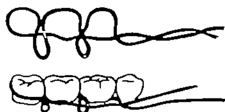
D —Fixation of mandibular fracture in an edentulous jaw may be obtained by driving a Kirschner wire across the fracture (Brown, McDowell) General endotracheal nasal tube anesthesia is preferable for this procedure The fracture is reduced and held by an assistant A small incision is made in the chin and, using a motor-driven drill, one or two Kirschner wires are driven through the fragments and across the fracture Care is taken to avoid penetrating the inferior alveolar canal A small dressing is placed over the cut ends of the wire The wires are removed after the fracture has healed

PLATE 19

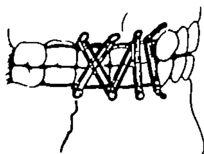
A



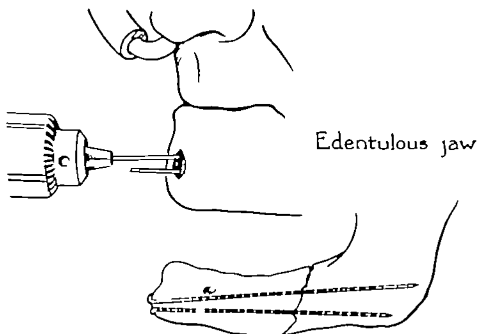
B



C



D

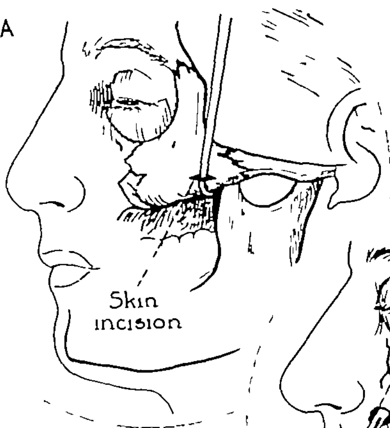


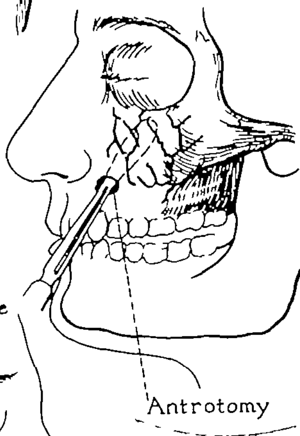
A —Many zygomatic fractures may be reduced by elevating the fragment with a jaw hook or periosteal elevator Procaine is injected into the fracture site and surrounding soft tissues and a small stab incision is made over the inferior rim of the zygoma The hook is passed through the stab wound to engage the inferior edge of the displaced fragment The bone is lifted upward and pulled outward, there is frequently a click as the fracture is reduced If the reduction is satisfactory, palpation will demonstrate a return of normal contour to the lateral orbit and a smooth infraorbital ridge No splinting is required

B —Severe, unstable, badly comminuted fractures, with associated fracture of the maxilla are best reduced through the antrum A horizontal incision is made, as in a Caldwell-Luc operation (see Antrotomy, Chapter 9), above the gingiva in the canine fossa, and the antrum entered Using a blunt forceps or sound within the antrum and applying external pressure, the comminuted fragments are molded into place While the antrum is open it is advisable to construct a small naso-antral window (see Chapter 9) A gauze pack is inserted into the antrum to maintain reduction This pack is removed in about 10 days, following which the incision in the canine fossa heals rapidly

C —The Gillies approach may be used when the fracture involves the zygomatic arch, particularly when it is driven into the coronoid process of the mandible A transverse incision is made within the hair line over the temporalis muscle and deepened through the temporalis fascia A flat periosteal elevator is introduced beneath the temporalis fascia where it will be guided on the surface of the muscle downward beneath the zygomatic arch Outward and upward pressure against the zygoma is then exerted and the fracture reduced The incision in the temporalis fascia is closed with interrupted sutures of cotton or catgut and the skin approximated with fine silk No drainage is required

PLATE 20


A
Skin
incision


B
Antrotomy


C
Through fascia
Over temporalis muscle

A—The fracture line in the lowest lying member of this group (Guérin) extends transversely across the maxillas just above the apices of the teeth, detaching the entire alveolus

B—The fracture is reduced by manipulating the upper alveolus until the upper and lower teeth are correctly aligned Fixation of this fracture may be obtained by suspending the alveolus to the orbital borders An incision 1 5 cm in length is made over each inferior orbital rim and oblique drill holes placed Stainless steel wires are inserted through the drill holes and passed subcutaneously over the surface of the maxillas and into the mouth at the buccal sulcus The wires are then fixed to an arch bar ligated to the upper teeth Interdental wiring (see Plate 19) also affords adequate fixation

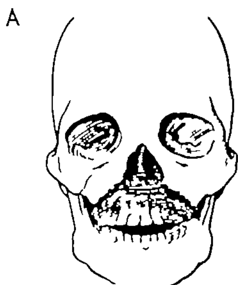
C—In the higher pyramidal mid-face fracture, the maxillas and nose are separated en bloc at the frontonasal and zygomatic maxillary sutures and driven backward

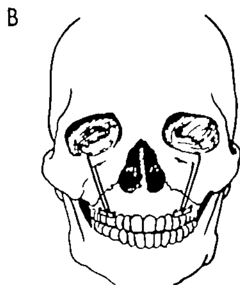
D—Reduction is made by pulling the mid-face bloc forward, and fixation is obtained by interdental wiring and, at times, by driving a Kirschner wire transversely across both zygomas In addition, reduction and fixation of the nasal bones may be necessary

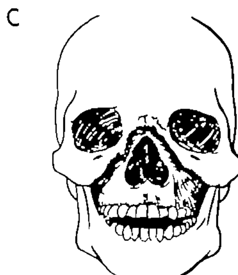
E—In the still higher level fracture, the lines extend across the nasofrontal suture, through the inner and outer orbital walls, and across the zygomatic bones separating them from the frontal bone

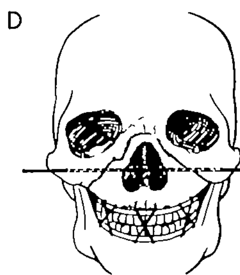
F—Considerable force is required to bring the mid-face forward and is obtained by applying lion jaw forceps to the maxilla at the hard palate and upper buccal sulcus The fractures of the orbit, nasal bones, and zygomatic arch require separate reduction and fixation Fixation of the entire bony mass to the cranium can be achieved by wiring the maxillas to the frontal bones Incisions 2 cm in length are made at the outer canthus above the frontozygomatic suture and drill holes are made through the zygomatic processes of the frontal bones Steel wires are passed through the drill holes and along the posterior surface of the zygomas into the mouth through the buccal sulcus The wires are then twisted to an upper dental arch bar, thus holding the maxillas firmly to the cranial bones In addition, interdental wiring is usually required

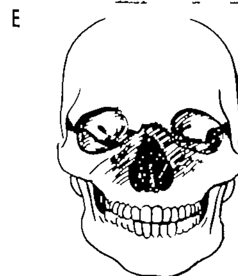
PLATE 21

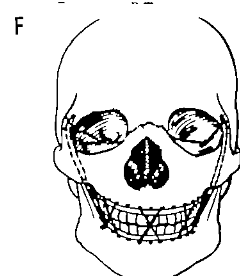












CRANIOCEREBRAL INJURIES

Head injuries constitute a problem of increasing magnitude in every community To reduce the mortality and morbidity from these injuries it is essential, first, that more effective supportive treatment be given the nonsurgical cases, second, that initial surgical treatment for the compound injuries be complete, and, third, that the development of complications requiring surgical treatment be recognized early and treated promptly

Head injuries in general can conveniently be divided into 3 groups (1) closed injuries in which surgery is not indicated, (2) compound wounds demanding surgical attention, and (3) injuries in which secondary complications requiring surgical treatment arise The distribution of head injuries between these groups will vary somewhat, but in general the surgical cases will represent only 10-15% of the total

Nonsurgical Injuries

Most serious head injuries are nonsurgical, but there are many therapeutic measures which must be utilized to obtain maximal survival and minimal disability in this group It is helpful to think of serious brain trauma as producing at least two zones of injury—a central zone in which damage is irreversible and tissue death occurs, surrounded by a secondary zone in which function is temporarily abolished but in which tissue recovery is possible Although the central zone of irreversible change may not be reduced, it can all too easily become more extensive Any change unfavorable to cerebral cellular metabolism will extend tissue death into areas already insulted by trauma Thus, a few moments of impaired oxygenation or a short period of hypotension may convert an otherwise recoverable injury into one that is fatal Similar extension of tissue damage may result from hyperthermia, dehydration, or starvation

The most important clinical variable influencing tissue survival is the patient's airway An unconscious patient should never be left on his back, because a flaccid tongue, nasal and pharyngeal secretion, blood, and often vomitus, may combine to obstruct the airway

Such a patient should be on his side with his face forward and his mouth dependent If the patient is deeply comatose an endotracheal tube should be passed or a tracheostomy done to allow tracheal suction to prevent further aspiration and to assure a free airway

Shock with resulting cerebral vascular hypotension can also greatly aggravate brain injury With few exceptions shock cannot be attributed to the head injury alone and other complications must be sought With multiple injuries extremity fractures or peripheral blood loss are obvious causes for shock In the presence of serious head injury initial fracture treatment should be confined in most instances to simple immobilization

In addition to the maintenance of optimal oxygenation and peripheral blood flow it is important that hydration and nutrition be adequate Normal fluid balance should be maintained, and in patients unconscious more than 48 hours tube feeding should be used to assure adequate nutrition

Central hyperthermia may occur as a result of contusion injury in the hypothalamic area, particularly in patients with basal fracture It will typically occur within 1 to 24 hours after injury and may be severe and rapidly fatal unless vigorously combated Patients with central hyperthermia must be actively cooled using ice bags and alcohol sponging often aided by an electric fan to blow air across the body to increase surface evaporation

Compound Cranial Wounds

Compound cranial wounds require meticulous and complete debridement and closure The extent of damage underlying the compound fracture wound is typically more severe than would be anticipated from inspection and x ray examination Bone fragments markedly displaced at the time of impact often come to rest much closer to their normal positions Thus extensive dural tearing with underlying laceration and hemorrhagic maceration of brain tissue is frequently found beneath rather mild appearing comminuted fractures Unless delicate but thorough debridement of macerated brain tissue is carried out, followed by accurate and complete closure of the dura, the incidence of serious complications in the

form of infection and late epilepsy will be substantially increased The treatment of such wounds should not be undertaken unless adequate suction and coagulation facilities are available Patients with head wounds tolerate transportation surprisingly well during the first 24 hours after injury and with the protection of antibiotics the traditional time limits for primary repair have been greatly extended If the patient is to be transported for treatment, it is advisable to do nothing more than apply massive dressings and start antibiotic therapy, except in cases in which bleeding from the wound appears excessive Such bleeding is usually from small scalp arteries and if some time may elapse before definitive treatment is carried out, the scalp edges should be inspected and bleeding points controlled by simple ligature without disturbing the rest of the wound

The obvious compound skull fractures are those involving the cranial vault with wounds of the scalp, but fractures may also be compounded through the paranasal sinuses and middle ear Fractures crossing the floor of the anterior cranial fossa may crack the cribriform plate, tearing the dura and mucosa of the ethmoid or frontal sinuses, producing a spinal fluid fistula with "watery" blood draining from the nose Less frequently, fractures may involve the sphenoid sinus with fluid draining into the posterior nasopharynx and throat Before the advent of antibiotics, such fistulas constituted surgical emergencies because of the hazards of infection At present, it is possible to wait days or even weeks for spontaneous closure of the fistula, which will occur in most instances If closure does not occur, the fistula can be repaired surgically as an elective procedure Posterior fractures through the petrous ridge may be compounded into the middle ear If the tympanic membrane is torn, there will be bloody fluid drainage from the ear canal If the eardrum remains intact, it will appear bulging and dark bluish on otoscopic inspection, and occasionally a small amount of dark blood will be seen on the posterior pharyngeal wall below the orifice of the eustachian tube If bloody fluid is draining from the ear canal, it should be allowed to drain freely and the ear should not be cleaned or otherwise disturbed In these cases, the fistula almost invariably closes spontaneously without complication

Basal skull fractures are more often diagnosed clinically than

visualized by roentgenogram. The drainage of bloody watery fluid from the nose or ear is positive clinical evidence of such fracture. In addition, the rapid development of protruding orbital ecchymosis in the absence of direct trauma to the orbital area indicates fracture into the orbit usually involving the floor of the frontal cranial fossa. Fractures in this area also may be indicated by the appearance of a discrete wedge-shaped hemorrhage in the scleral layer of the eyeball extending to the lateral margin of the iris. Another less immediate indication of basal fracture is the appearance of ecchymosis in the sulcus behind the ear anterior to the mastoid bone—"Battle's sign." Fractures involving the cranial vault often may be identified by palpation through the intact scalp or by inspection of an open wound. Another reliable indication of underlying fracture of the vault is the appearance of rather diffuse ballottable swelling beneath the scalp. This results from accumulation of fluid between the skull and galea and is readily differentiated from the more limited nonballottable swelling produced by hemorrhage and edema superficial to the galea.

Complications Requiring Surgery

From the large group of patients initially classified as nonsurgical, there will be a few who develop intracranial hematomas requiring evacuation. If these patients are to survive without increased disability, it is essential that they be identified early and treated promptly. The first essential is to have an accurate record of the patient's neurologic status as soon after injury as possible against which subsequent evaluation of his course can be made. The most important indicator of the patient's status is his level of responsiveness, which can be plotted on a hypothetical curve of decreasing function from the normal level of full responsiveness to the end point at which the patient is dead. Patients whose injuries place them at the upper levels of this curve show lethargy but preservation of complex verbal and motor responses, while those at lower levels will show progressive reduction of verbal responsiveness and loss of spontaneous and purposeful motor function. Below the midpoint on this curve, verbal response cannot be elicited and the patient is in coma. In upper levels of coma, motor

responses to pain may still be well integrated and moderately purposeful but, as the coma deepens, motor responses become more diffuse and the patient shows crude mass withdrawal reactions to pain stimuli With more severe injury, this mass motor response changes to the extensor rigidity characteristic of "decerebration" Beyond this point, evidence of brain stem damage is marked with preterminal changes in respiration (Cheyne-Stokes), pulse (slowing), and blood pressure (widening) due to medullary impairment

An accurate but simple written description of the patient's level of response is the first essential in following his progress Any decline of responsiveness should immediately arouse suspicion of a developing surgical complication

Although brain damage inflicted at the moment of injury cannot be altered, subsequent damage from hematoma formation can be identified and treated early if the patient's course is followed carefully

In addition to the decline in level of response, the patient may or may not show localizing neurologic changes indicating the site of further injury The most common localizing signs are lateralized pupillary dilatation and extremity motor weakness Typically, pupillary dilatation is on the side of involvement and paresis is opposite the side of involvement, although in rare instances, due to shift of the hemispheres, both signs may be reversed Motor paresis may be picked up at any level of responsiveness more accurately by inequality of movement in response to stimulation than by reflex changes which may be difficult to interpret

The subdural hematoma which typically results from tearing of veins crossing the subdural space may develop as a late complication, usually 1 to several weeks following injury It may occur in the absence of apparent trauma to the head, and if untreated will end fatally When subdural hematoma is kept in mind, it will be suspected in patients who show gradual neurologic deterioration, and, if suspected early, the diagnosis and treatment (multiple burr holes) can be done as an elective procedure

The most dreaded *early* surgical complication is the extradural hematoma This lesion results from tearing of the dura across the middle meningeal artery or its branches, with arterial bleeding between the skull and dura It is almost always associated with

fracture, most frequently of the temporal bone The rate of development of brain compression from such a hematoma depends on the size of the artery torn and the ease of separation of dura from the skull

The classic clinical history for extradural hematoma is well known—a head injury with recovery of consciousness followed by loss of consciousness and progressively deepening coma ending in death The course may be as short as 3 or 4 hours from injury or as long as 24 to 36 hours Extradural hematoma may also occur with minor brain injury and no loss of consciousness or may be superimposed on more severe brain contusion and laceration in which case there will be no interval of recovery of consciousness In every case the crucial clinical change is a progressive decline in levels of responsiveness Lateralization of the hematoma is frequently established by the appearance of the localizing neurologic signs mentioned However the most reliable indicator of the side of the hematoma is the fracture line since dural tearing beneath the fracture initiates hematoma formation X ray studies should include right and left lateral views of the skull for accurate localization of the fracture line The surgical approach should be guided by the site of fracture which is most often through the temporal bone but sometimes extends posteriorly into the parietal area or anteriorly into the frontal region

If the possibility of extradural hematoma is kept in mind and the patient carefully observed, a decrease in the level of responsiveness will be noted and the diagnosis suspected in time to secure the assistance of a neurosurgeon On occasion, however the signs of cerebral compression may progress so rapidly that immediate surgery becomes mandatory In such an emergency the general surgeon should be prepared to evacuate the clot as a life saving measure

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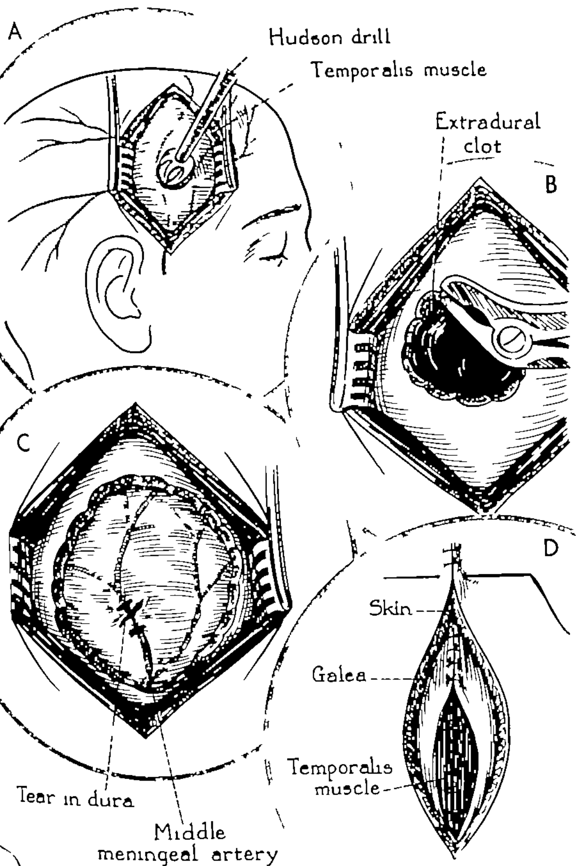
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A
Hudson drill
Temporalis muscle
Extradural
clot
B
C
D
Skin
Galea
Temporalis
muscle
Tear in dura
Middle
meningeal artery

Evacuation of Extradural Hematoma

The presence of an extradural hematoma may be one of the most urgent emergencies in surgery and require immediate operation and evacuation of the clot if the patient is to survive Strict adherence to neurosurgical principles must be maintained Hemostasis within the cranium must be complete and can be obtained either by silver clips, coagulation by the electrosurgical unit, or by suture of the dura Flat cotton pledgets are used for sponges Bleeding from the bone can be controlled with bone wax

A —Most extradural hematomas are caused by hemorrhage from the middle meningeal artery or its branches, hence the incision used is planned to expose this artery Under local anesthesia, a vertical skin incision 8-10 cm in length is made in the temporal region, placed on a line 2 cm in front of the ear and perpendicular to the zygoma Pressure on each side of the incision will control bleeding until skin clips or straight hemostats are applied The incision is deepened through the galea, temporalis muscle, and periosteum The wound is held open with self-retaining retractors A trephine opening, using a Hudson drill, is made through the squamous portion of the temporal bone below the origin of the temporalis muscle Because the hemorrhage results from a tear in the dura at the site of fracture, the fracture line in the temporal bone is the best guide to the bleeding vessel

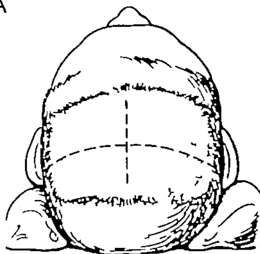
B —Using a flat bone rongeur, an area of temporal bone about 8 cm in diameter is removed, thus making a fairly large bony decompression beneath the temporalis muscle

C —The extradural clot is removed by a combination of irrigation and suction The middle meningeal artery and its branches can now be seen on the surface of the dura and the bleeding point is controlled by the application of silver clips or sutures At times, control of the artery can be obtained by plugging the foramen spinosum with a small pledget of cotton or bone wax

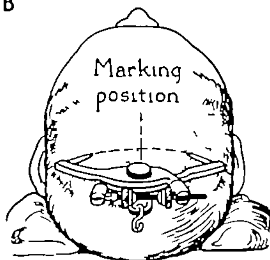
D —The bone defect is left open but the wound is closed meticulously in multiple layers, using fine interrupted silk sutures for the temporalis muscle, fascia, galea, and skin There will often be a prompt recovery of consciousness soon after the extradural clot is removed

PLATE 23

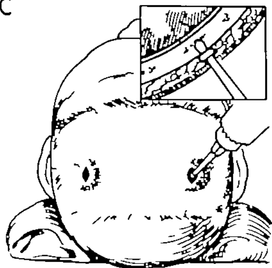
A



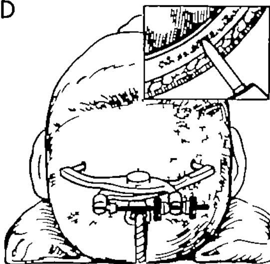
B



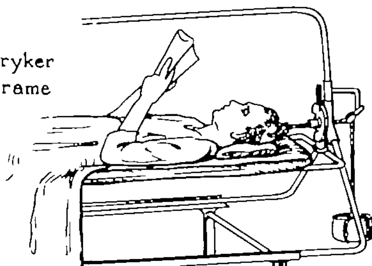
C



D



E



Fracture of the Cervical Spine

Fracture and fracture dislocation of the cervical vertebrae with or without cord involvement may occur as the result of any severe neck trauma Dislocations of C5-C6 or C6-C7 are commonly found in automobile accidents When cervical spine injury is suspected, extreme care must be taken during examination and transportation of the patient Support to either side of the neck must be provided and neck flexion prevented Traction is generally required in the treatment of these injuries, skeletal traction is the most comfortable It is most effectively obtained through the use of tongs inserted through the outer plate of the parietal bones Maintenance of traction and continued nursing care can be obtained through the use of the Stryker bed frame

A —The patient is transported to the operating room on the admitting room stretcher in the supine position and is not moved to the operating table The head is supported in a face-upward position with sandbags on either side of the head The parietal area of the scalp is shaved, prepared, and draped, care being taken to move the head as little as possible It is important that the tongs be applied in the correct position To obtain this position, a line is scratched in the midline of the skull in the sagittal plane An additional line is drawn from one mastoid process to the other, bisecting the midline mark

B —With the sterile tongs in a neutral position, they are placed with the center of the tongs on the midline mark, and skin scratches are made with the tong points on the line drawn from the mastoid processes These points mark the position for procaine injection

C —Procaine is injected and a small incision made through the scalp and periosteum Using the Crutchfield drill and drill points, a drill hole is placed in the outer table of the skull at an angle approximately equal to that of the tong points

D —The points of the tongs are inserted into the drill holes and tested to see that they have no lateral motion With the tong points held securely in place, the set screws are tightened

E —With traction maintained, the patient is placed on a Stryker frame As much as 35 lb traction is required the first 24 hours for reduction of a dislocation This is then reduced to 5-15 lb for maintenance of traction

is older The capillary hemangioma or port wine stain is a permanent blemish A few such lesions are small enough for excision with primary closure to be successful Others may be eradicated by staged partial excisions or by excision and skin grafting Cosmetic preparations are used to hide the larger port wine stains in which complete surgical removal is impossible

Most other benign lesions of the skin of the head and neck are relatively simple to manage They are removed for cosmetic reasons and because some particularly hyperkeratoses and pigmented nevi, may undergo malignant transformation Although electrodesiccation has been widely used for many of these small growths we greatly prefer surgical excision so that tissue for microscopic study may be obtained

Malignant Tumors

Many early skin cancers have such a typical appearance that they may be excised primarily without a biopsy The margin of normal appearing skin which should be excised with a skin cancer is variable A margin of 0 5 cm of normal appearing skin around a typical adnexal cell carcinoma with well-circumscribed edges is adequate, while a margin of 1 0-1 5 cm. should be obtained around an obvious squamous cell carcinoma Larger lesions and those with surrounding induration and inflammation which will require more extensive surgery should be biopsied before definitive excision The possibility of deep as well as lateral extension should not be ignored and the lesions should have excision in depth proportional to the lateral margins Radical neck dissection for squamous cell carcinomas of the skin of the head and neck is not performed until evidence of cervical lymph node metastasis appears

The recurrence of cancer of the skin of the head and neck following inadequate surgery or radiotherapy present a more difficult problem The margins of many recurrent tumors are poorly defined and microscopic extension of tumor cells beyond any gross evidence of disease is a common finding These tumors require a wide excision and often skin grafting It is important to obtain immediate pathologic examination with frozen sections to assure adequacy of excision.

CHAPTER 6

The Skin of the Head and Neck

BENIGN LESIONS

HEMANGIOMAS occur more frequently in the skin of the head and neck than elsewhere in the body The lesions are present at birth or appear within the first few months of life Three general types may be recognized clinically the capillary hemangioma or port wine stain, the arteriovenous hemangioma (hemangioma simplex) or strawberry mark, and the more deeply located cavernous hemangioma Often a mixed type is present, with both a superficial arteriovenous element and a deeper cavernous component The arteriovenous hemangioma is the most commonly seen It is important in dealing with this type of hemangioma to remember that most arteriovenous hemangiomas are self-limiting growths which disappear spontaneously Only a few behave in an aggressive manner, with rapid growth, ulceration, and bleeding We are opposed to any type of radiotherapy for these benign lesions, since they will respond to far simpler measures and since even the most carefully administered irradiation in an infant may have serious sequelae later in life One to three applications of solid carbon dioxide usually will result in complete regression of these superficial hemangiomas, with minimal residual skin changes

Cavernous hemangiomas respond less readily to simple methods of therapy, and spontaneous regression is less common These lesions may be obliterated or greatly reduced in size by repeated injection of small amounts of a sclerosing agent Scarred remnants which constitute a cosmetic problem are excised when the child

Larger scalp defects must be covered with split thickness skin grafts or rotation flaps Primary suture usually can be obtained after excision of lesions of temples zygomatic region and cheeks

Only very small tumors of the skin of the nose may be excised adequately and primary closure obtained More extensive involvement of the nose requires some type of plastic coverage after excision A generally satisfactory method is the rotation of a pedicle flap from the adjacent cheek The use of a full thickness graft taken from the skin of the mastoid or postauricular region also provides an acceptable cosmetic result The skin of the ear is thin and subcutaneous tissue is sparse All but the most superficial lesions in this region, when treated surgically require a wedge type excision of the full thickness of the ear The lining of the external auditory canal may be entirely excised and replaced by a split thickness skin graft in the management of tumors in this location In considering lesions of the eyelids the surgeon is faced with the problem of ectropion or lid deformity following excision For this reason, we prefer radiotherapy for the treatment of many lesions close to the lid margin

Reconstructive Procedures

The timing of secondary reconstructive procedures for full thickness defects of the skin of the head and neck is important. It is essential that all infection be resolved before such surgery is undertaken. In the case of defects following treatment of cancer the patient should generally have been observed for at least a 9-month period without evidence of recurrence Otherwise skin flaps may hide recurrent cancer and lead to a catastrophe In the interim, temporary prosthetic devices and individualized dressings are used to make the patient as comfortable as possible Although this text is not primarily concerned with plastic surgery we have included a few of the reconstructive procedures which have proved most useful, since it is inevitable that the general surgeon will encounter situations in which the use of skin flaps and delayed repair becomes necessary The reader is referred to one of several excellent texts on plastic and reconstructive surgery for more comprehensive discussion

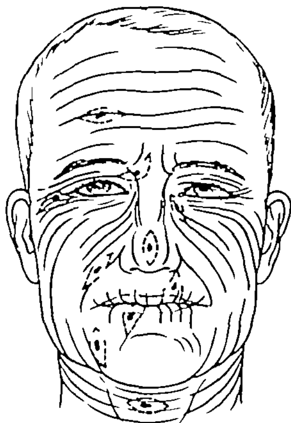
Pigmented lesions suspected of being malignant melanomas must be totally excised rather than biopsied If the tumor appears grossly malignant, a margin of excision of 2-3 cm of normal-appearing skin beyond any pigmentation or induration is required If there is some doubt that a pigmented lesion of the face is actually malignant, a more conservative excision may be permissible Immediate microscopic study should then be carried out and a wide excision performed if a diagnosis of melanoma is made Adequate local excision in depth as well as width is the most important measure in the control of melanomas of the skin of the head and neck Lymph node dissections usually are reserved until evidence of regional metastatic disease appears Occasionally, an exception is made for the melanoma which immediately overlies a node-bearing area For example, a resection of the superficial portion of the parotid with its included lymph nodes would be performed in continuity with excision of a melanoma of the skin overlying the parotid gland

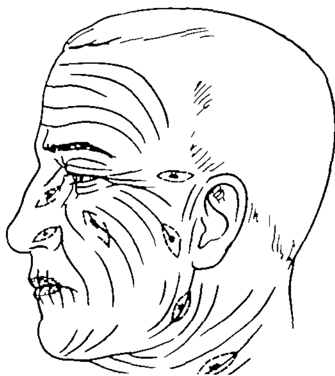
Management of Skin Tumors in Specific Locations

The surgical management of a tumor of the skin of the head and neck may be simple or complex, depending on the size and location of the lesion Excision with primary closure of the wound along normal skin lines is the most desirable method of treatment However, many lesions are too large for this technic or are located in an area in which primary closure will be somewhat less than satisfactory

The skin of the neck may be widely undercut so that rather large wounds can be closed without difficulty Occasionally, a relaxing incision or the rotation of a flap of adjacent skin is required to cover an extensive defect The scalp, on the other hand, has little elasticity, and elliptical defects as small as 2 cm in width may be difficult to close Considerable tension may be placed on sutures in the scalp, however, with satisfactory wound healing

PLATE 24





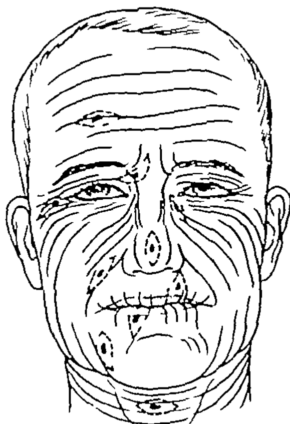
Excision of Skin Tumors of Face and Neck

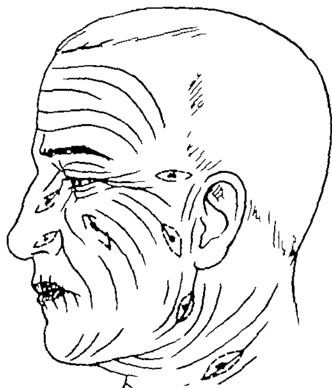
Achievement of a good cosmetic end result is almost as important as eradication of the tumor when a small lesion lies exposed on the face or neck It is well known that scarring is minimal if the incision follows certain skin lines, while a broad, unsightly scar may result from an incision across these lines The skin lines of the face and neck are generally at right angles to the direction of pull of the underlying muscles of expression, and vary in a number of ways from the lines of Langer described in numerous textbooks The lines here illustrated were adapted from the studies of Rubin and Kraissl and Conway They vary somewhat in individual patients and the surgeon can best determine the direction of skin lines by having the patient grimace, wrinkle his forehead, or smile

With the exception of melanomas, most small primary skin cancers of the face and neck may be excised with an adequate margin and primary closure obtained The cosmetic result will be satisfactory if the incision is planned to conform to normal skin lines and the surrounding skin is undermined adequately Although the appearance and chance of cure may be equally good in the hands of a capable radiotherapist, we prefer excision for all skin cancers of the face except those close to the margin of the eyelid Surgical treatment has the great advantage of permitting microscopic evaluation of the completeness of eradication of the tumor

In the management of large skin lesions and many recurrent tumors, primary closure should not be attempted since the tension, even after the undermining, will tend to distort tissues and produce unsightly scars Here the surgeon must adopt the most applicable one of a number of available plastic technics for closure These include split-thickness and full-thickness skin grafts, rotation flaps, and tubed pedicle flaps

PLATE 24





Local Excision of Skin Tumor

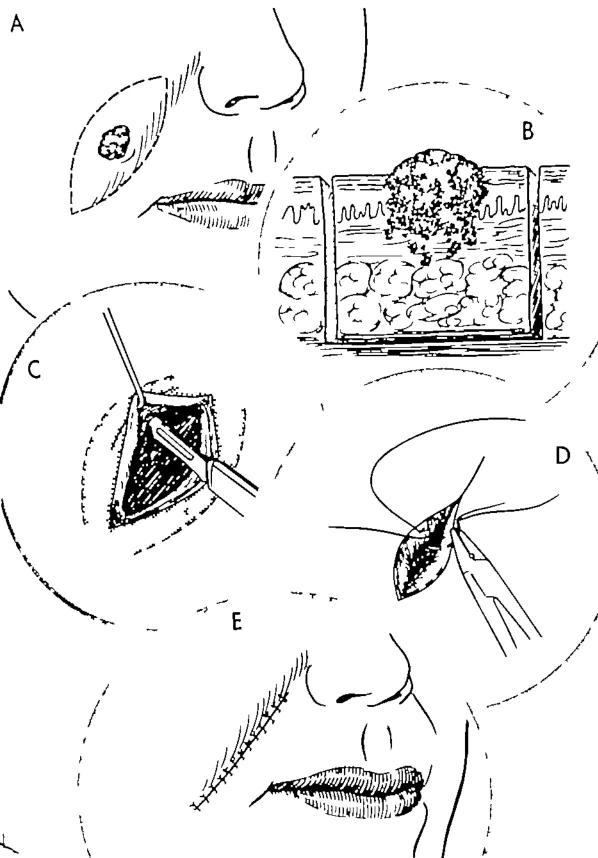
A.—The direction of skin lines and wrinkles in the area of the lesion is determined. An elliptical incision is planned to conform to the skin lines and to leave an adequate margin of normal-appearing skin around the tumor. The ellipse should be about four times as long as it is wide and the two sides of the ellipse should be approximately equal, to facilitate closure. It is frequently of value to outline the proposed incision with a pointed wooden applicator dipped in methylene blue dye before commencing.

B.—Local infiltration or regional block anesthesia is used. A scalpel with a no. 15 blade is used for the excision. The blade should be held at right angles to the skin to avoid beveling. The excision of an adnexal cell or squamous cell carcinoma should extend well into the subcutaneous tissue to secure an adequate margin in depth. The tissue is removed in one block.

C.—The surrounding skin edges are then widely undercut to allow closure without tension. A satisfactory method of accomplishing this is to elevate the skin edge with a small shepherd's hook and incise laterally beneath the skin with the scalpel or sharp scissors. Following undercutting, all bleeding vessels are secured with ties or sutures of 4-0 chromic catgut.

D.—The subcutaneous tissues and derma are then approximated so that the skin margins lie close together. This is accomplished by numerous sutures of 4-0 chromic catgut placed so that the knots are buried. If this is done carefully, there will be no tension on the skin sutures and a fine scar will result.

E.—Interrupted sutures of 4-0 or 5-0 silk are now placed close to one another in the skin, not over 2 mm. from the wound margins. There should be no tension on these sutures. A dressing of dry gauze is applied with moderate pressure. Elastic bandages around the head for 24 hours are often valuable in securing even pressure in difficult locations. The skin sutures are ordinarily removed on the 4th postoperative day and the wound margins held in approximation by collodion gauze strips (see Dressings, Chapter 3).


A
B
C
D
E

A—Benign and malignant neoplasms of the external ear occur most commonly on the helix Less often, more central portions or the external auditory canal are involved Benign lesions and occasionally superficial early cancers may be excised locally with preservation of the cartilage Primary closure of the defect or application of a small split-thickness graft is then performed Most carcinomas of the ear, however, can be safely excised only by including the underlying cartilage Local anesthesia is obtained by infiltration either around the tumor or completely around the root of the ear A wedge-shaped incision is outlined around the tumor, leaving adequate margins and making the two sides of the wedge as near equal in length as possible The full-thickness segment of the ear is excised

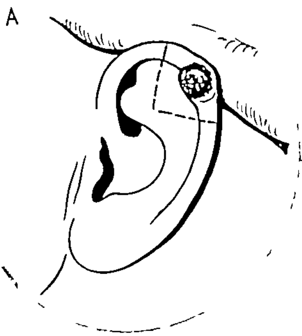
B—Closure of wedge-shaped defects is accomplished by numerous sutures of 4-0 silk approximating the skin edges on both sides of the ear No sutures are necessary in the cartilage Larger lesions require more extensive removal of the external ear, and repair may involve transfer of adjacent skin flaps or the use of prostheses

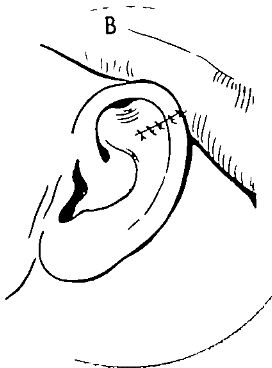
C—Many small lesions of the nose may be locally excised and primary closure obtained Larger defects may be covered with a full-thickness skin graft Full-thickness grafts obtained from the postauricular region most nearly approach the skin of the face in color and texture The lesion is excised with adequate margins, care being taken not to bevel the skin edges

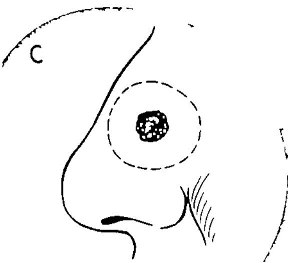
D—An accurate pattern of the defect is cut out of linen or sterile blotter and traced on the skin of the postauricular region The full thickness of the skin is then incised to fit the pattern Several fine silk sutures are used for traction as the full-thickness graft is excised with a small, sharp scalpel No subcutaneous fat should remain on the graft The donor site is closed by undermining and advancing local flaps

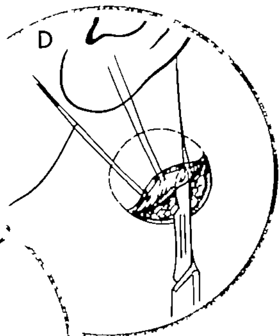
E—The full-thickness graft is placed in the defect and accurately approximated to the surrounding skin edges without tension by many small stitches of 5-0 silk A layer of fine-mesh gauze is applied and covered with a bulky dressing of gauze or sea sponge to maintain even, light pressure over the graft If this procedure is performed with extreme gentleness to avoid trauma to the graft, the success of such full-thickness skin grafts will be high

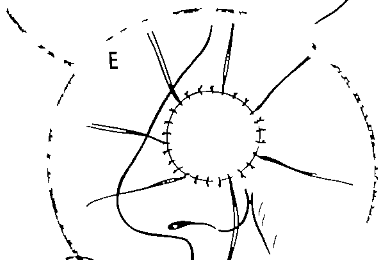
PLATE 26











] *Utilization of Adjacent Flaps to Close Defects*

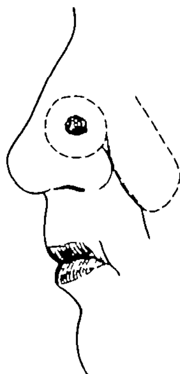
Defects of the face and scalp which cannot be closed primarily by undermining and advancing skin edges may often be covered by rotating or sliding flaps from adjoining areas The donor site is closed primarily, or covered with a split-thickness graft if it is in a less conspicuous location A flap should always be slightly larger than the defect to be covered If there is the slightest suspicion of inadequate blood supply as the flap is elevated, it should be resutured in its bed and transfer delayed for about 3 weeks

A —A nasolabial skin flap may be mobilized and rotated to cover large defects of the side of the nose It is frequently wise to raise the flap in stages if its circulation is not excellent The skin of the cheek is undermined and advanced without difficulty to close the donor area For full-thickness defects of the nose, the nasolabial flap is lined on its deep surface with a split-thickness graft several weeks before its transfer

B —The principle of the rotation flap is frequently useful for defects around the eye, where closure of the wound would otherwise lead to ectropion The lesion is excised with adequate margins and the defect reduced to a triangular shape A curved incision is then made as a continuation of the short side of the triangle, being at least 4 times its length A small triangle of skin is excised at the termination of this incision The flap is then widely undermined and advanced to effect closure without tension on the eyelid

PLATE 27

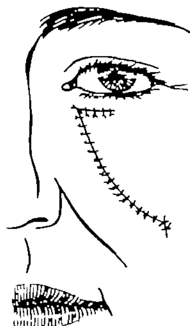
A





B





Closure of Cheek Defect with Tube Flap

Use of the tubed pedicle flap is here illustrated for the delayed reconstruction of full-thickness soft part defects following trauma or destructive surgery for cancer It is often impossible to construct the flap on the cervical region because of scarring from previous surgery In such a situation, an acromiopectoral tubed flap must be formed and if necessary migrated in several stages to the defect Because of full-thickness loss of the cheek in the case illustrated, the end of the flap must be lined with a split-thickness graft or folded on itself to provide an epithelial lining within the mouth

A —Careful measurement and planning before surgery is essential so that the end of the flap will reach and close the defect adequately Parallel incisions are made along lines marked out previously with methylene blue dye The skin and subcutaneous tissues are undermined between the two incisions and the adjoining skin edges are also undermined widely

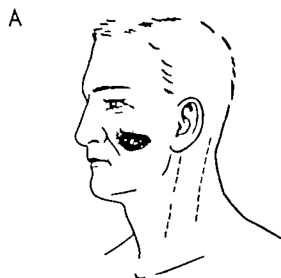
B —The edges of the central flap are inverted and accurately sutured together to form a tube, the ends of the sutures being left long to aid in exposure of the extremities of the tube The flap bed is then closed by advancing the medial and lateral skin margins to be approximated beneath the tube If this procedure requires undue tension, the raw surface may be covered with a split-thickness skin graft

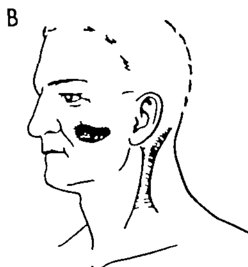
C —For additional length, after a 3-week period the lower end of the flap may be lengthened but left untubed In several stages at 3- to 4-week intervals, the distal end is freed and folded on itself, the donor bed being covered with a skin graft

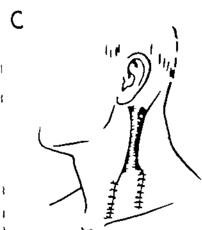
D —When circulation to the lower end of the flap from above is assured, transfer is possible All scar tissue is excised from the edges of the cheek defect and the flap fixed in place with fine silk sutures approximating the mucosal and skin surfaces to the incised edges of the flap

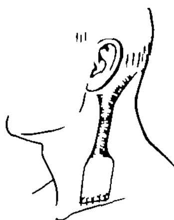
E —After further delay, and tests with a rubber tourniquet to insure adequate blood supply from the recipient area, the unused portion of the tube is excised and the flap further adjusted in place Final revisions to minimize scarring may be completed after several weeks

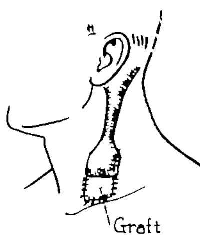
PLATE 28

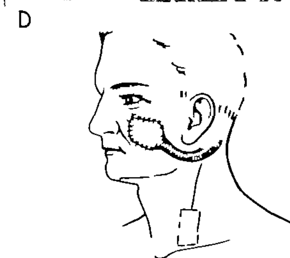


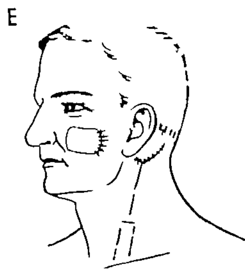










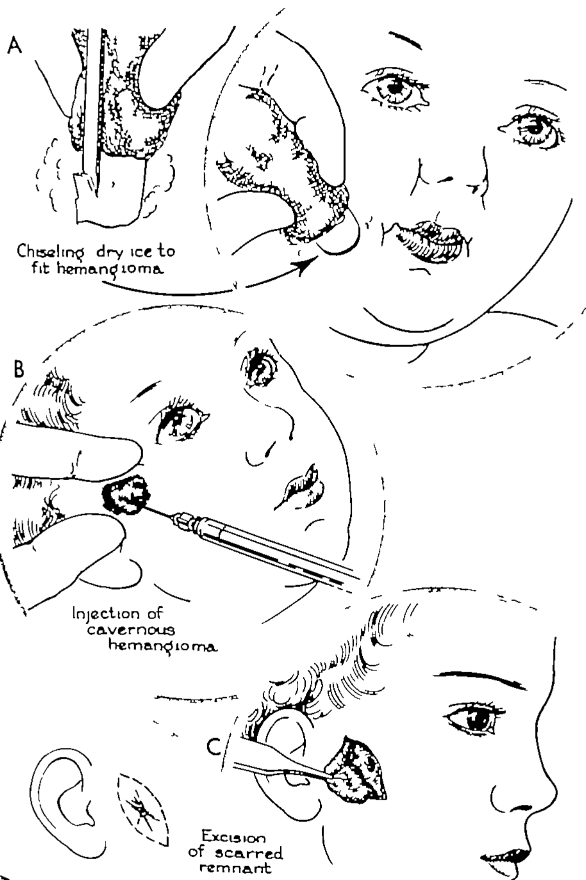


Many hemangiomas, particularly the superficial arteriovenous hemangiomas or strawberry marks, will undergo spontaneous regression with growth of the child Aggressive treatment of such benign growths is not indicated and small, inconspicuous lesions may be merely kept under observation and the parents reassured If therapy is decided on because of the extent of the hemangioma or at the insistence of the parents, simple measures which will have no ill-effects on the child should be used Treatment is usually deferred until 3-6 months of age unless rapid enlargement, ulceration, or hemorrhage requires more prompt measures

A —The common superficial arteriovenous hemangiomas respond well to treatment with solid carbon dioxide A block of dry ice is cut or chiseled to the exact size of the lesion so that normal skin is not affected In large hemangiomas, only a portion of the lesion, about 4 square centimeters, is treated at one time The infant is restrained and the dry ice applied firmly to the lesion for 15 seconds Mucosal surfaces should have only a 10-second application Slight ulceration of the lesion which may appear in a few days is treated with a light dressing of petrolatum gauze From 1 to 3 dry ice applications at monthly intervals usually result in complete regression of the superficial hemangiomas, with minimal scarring

B —More bulky arteriovenous hemangiomas and cavernous hemangiomas are treated with sclerosing solutions, sodium morrhuate being most satisfactory The infant is restrained and digital pressure applied around the lesion A fine needle on a tuberculin syringe is inserted into the hemangioma and ¼ to ½ cc of sclerosing solution injected while the needle is constantly in motion Firm pressure is maintained over the lesion for 1 minute Injection is repeated at monthly intervals until maximal obliteration of the lesion has been obtained

C —Scarred remnants of hemangiomas persisting after injection therapy may be excised when the child reaches the age of 4 to 6 Any persistent area of skin involvement is excised by an elliptical incision in the direction of skin lines Dissection is carried closely around the lesion and the vessels entering its capsule are identified and secured Following excision, the wound is closed in layers with fine sutures More extensive skin involvement may require staged excisions


A
Chiseling dry ice to fit hemangioma
B
Injection of cavernous hemangioma
C
Excision of scarred remnant

Management of Hemangiomas

Many hemangiomas, particularly the superficial arteriovenous hemangiomas or strawberry marks, will undergo spontaneous regression with growth of the child Aggressive treatment of such benign growths is not indicated and small, inconspicuous lesions may be merely kept under observation and the parents reassured If therapy is decided on because of the extent of the hemangioma or at the insistence of the parents, simple measures which will have no ill-effects on the child should be used Treatment is usually deferred until 3-6 months of age unless rapid enlargement, ulceration, or hemorrhage requires more prompt measures

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commonly seen Every attempt should be made to obtain primary closure of such wounds by careful and anatomic approximation of tissues If this can be accomplished infection is seldom a problem and the end result is usually excellent from both a cosmetic and functional point of view

Among the benign lesions seen on the lips are cysts fissures patches of leukoplakia cutaneous horns and papillomas Most of these may be excised with little difficulty using local infiltration or regional block anesthesia The common type of cyst noted on the mucosa of the lip is the mucocele which is blue and may occasionally be confused with a hemangioma Incision and drainage of a mucocele are followed by prompt recurrence the entire lining must be excised for permanent control. Chronic fissures and leukoplakia are definite premalignant lesions and require removal Fissures and small patches of leukoplakia may be removed by conservative local excision More diffuse leukoplakia is most satisfactorily treated by the procedure commonly known as "lip shave" in which the entire exposed vermilion of the lip is removed

Cancer of the lip is second only to skin cancer in the frequency of malignant tumors of the head and neck Most malignant lesions of the lips are squamous cell carcinomas usually of a low histologic grade Adnexal cell carcinomas occasionally may extend to the vermilion of the lip from adjacent skin Malignant melanomas of the lips and tumors of ectopic salivary tissue are rare We have noted one example of a malignant neurinoma of the lip originating from a branch of the mental nerve Metastasis to cervical lymph nodes from a malignant tumor of the lips is relatively uncommon

Small early lip cancers several millimeters in diameter may be excised as a primary procedure without preliminary biopsy Larger lesions require biopsy before definitive therapy is undertaken. The frequently encountered lip cancers of moderate size may be treated successfully by either radiotherapy or surgical excision The cosmetic results of both procedures are good when they are carefully planned and carried out. We generally prefer surgical excision for the following reasons treatment time is shorter post treatment discomfort is less extended, and microscopic assurance of the adequacy of removal is possible Late ulceration of the lip has been noted in almost 25% of patients receiving radiotherapy

CHAPTER 7

The Lips

POSITION AND MOVEMENT of the lips are important factors in facial expression The surgeon should make every effort to obtain a satisfactory postoperative cosmetic result in this area as well as to preserve function All the muscles of the lips are innervated by branches of the facial nerve The ramus marginalis mandibuli supplying the triangularis and quadratus labii inferioris is particularly important and is prone to injury (see Neck Dissection, Chapter 15) The lips have an extremely rich vascular supply from the superior and inferior labial branches of the external maxillary artery, and ischemia or necrosis is seldom a surgical complication in this site

In repair of surgical or traumatic wounds of the lips, it is important to approximate the vermilion border with accuracy Breaks or notches in the usual smooth, sharp line of the vermilion border are quite noticeable and call attention to other scars in the region A small horizontal scratch with a scalpel or a mark with methylene blue dye on a pointed applicator may be made along the vermilion-skin junction at the point of the proposed incision This will allow accurate approximation when the wound is repaired

Surgical treatment is indicated for congenital and traumatic lesions of the lips as well as for benign and malignant neoplasms The treatment of cleft lips will not be described, since it lies more exclusively within the realm of the plastic surgeon Hemangiomas of the lips are treated in the same manner as hemangiomas elsewhere (see Chapter 6) Traumatic lacerations of the lips are

side and the opposite digastric triangle is also cleared of its contents In-continuity excision in which the lip is excised in continuity with the neck dissection is performed only for the most extensive tumors of the lip with involvement of the skin of the chin

In studying the records of patients who have died of cancer originating on the lip we have been impressed by the finding that the most difficult problem in management has been invasion of the mandible rather than metastases to cervical nodes The mandible may become involved by direct extension of a primary or recurrent tumor of the lip by spread through lymphatics which enter the *mental foramen, or by attachment of submandibular* nodes containing cancer Every effort must be made to detect mandibular involvement in advanced, recurrent, or metastatic lip cancer since if this development is not discovered and given early aggressive treatment, the cancer will become uncontrollable The management of mandibular involvement is outlined in Chapter 10

Its appearance has been most frequent about 2 years following treatment, but it may appear as early as 6 months and as late as 7 years after therapy Although most of these late effects of irradiation will heal with conservative management, surgical excision is occasionally required for a persistent ulcer Radiotherapy is contraindicated in the extensive and deeply infiltrating lesions of the lip, particularly those with mandibular involvement Such cancers require radical excision for control

Cancers occupying less than one third of the length of the upper or lower lip may be treated by a V or wedge excision, in which the full thickness of the lip and adjacent skin is removed with the lesion All points of the incision should be carried through normal-appearing tissue at least 1 cm from the margin of the tumor If doubt as to the adequacy of excision arises, immediate pathologic examination and frozen sections may be obtained before the wound is repaired Lesions occupying more than one third of the surface of the lip generally require one of the plastic types of repair illustrated on the following pages No type of primary repair is feasible in the most extensive cancer After wide excision of these lesions, the skin and mucous membrane are approximated around the edges of the defect wherever possible and a secondary reconstruction performed (see Wound with Full-Thickness Defect, Chapter 5)

Lymph channels from the upper lip drain mainly to nodes in the submandibular and preauricular regions Submental and submandibular nodes receive drainage from the lower lip Lymph node metastases from lip cancer occur in less than 10% of cases and node dissection is not indicated until clinical evidence of metastasis appears Each patient in whom a lip cancer is treated should be examined at regular intervals for a period of 5 years We follow such patients at 3-month intervals for the first 2 years and then once yearly If a node which clinically appears to contain metastatic cancer is discovered, a radical neck dissection is performed on the involved side Nodes which are enlarged but not entirely characteristic of metastatic disease are examined by needle biopsy or excisional biopsy before definitive surgery In the occasional instance in which one submental node near the midline is the site of metastasis, a neck dissection is performed on the involved

side and the opposite digastric triangle is also cleared of its contents In-continuity excision in which the lip is excised in continuity with the neck dissection is performed only for the most extensive tumors of the lip with involvement of the skin of the chin

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] *V Excision of Lip*

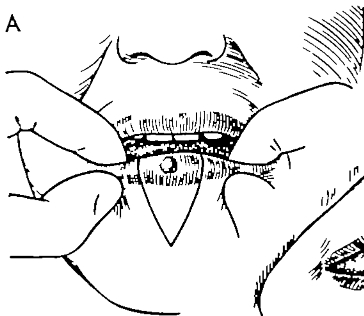
Benign lesions and the small, localized epitheliomas most commonly encountered are removed by a V or wedge-shaped excision of the upper or lower lip This procedure, if performed carefully, causes little if any disfigurement Up to one third of the width of the upper or lower lip may be removed by V excision with primary repair If further loss of tissue is necessary, the excision must be modified or combined with some other type of repair for a satisfactory cosmetic result

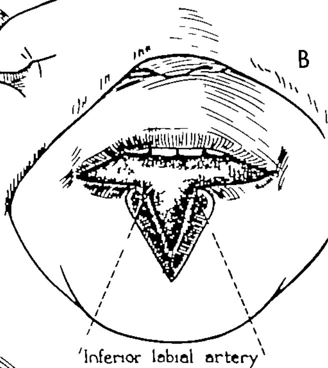
A —Regional nerve block anesthesia is ideal for the procedure (see Chapter 3) The line of incision is outlined around the lesion to be removed, allowing an adequate margin of normal skin Digital compression of the lip on either side of the incision controls bleeding The scalpel is held at right angles to the surface of the lip and the incision made through the full thickness of the lip The severed inferior labial artery is accurately seized with a mosquito clamp and is ligated with 4-0 chromic catgut

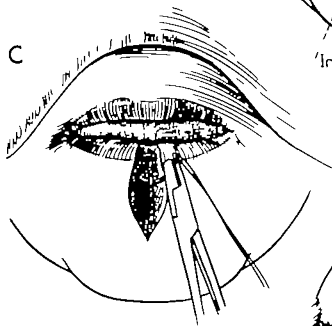
B —The excision of the wedge of tissue is completed If necessary, the apex of the wedge may be carried well down on the chin to clear downward extension of the lesion Hemostasis is carefully obtained with ligatures of 4-0 chromic catgut

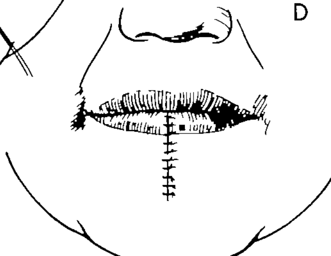
C —The orbicularis oris muscle is repaired with several interrupted sutures of fine chromic catgut Failure to reapproximate the muscle allows tension on the skin and mucosal sutures and thinning out of the repaired portion of the lip

D —Interrupted sutures of fine silk or nylon are used to approximate the skin and mucous membrane The first and most important suture should be placed accurately just at the vermilion border for a good cosmetic result The sutures through the exposed surface of the lip and the skin are then inserted Traction on these sutures will evert the lip, allowing the remaining mucosal sutures to be inserted No dressing is necessary The wound is kept clean by gentle removal of crusts which accumulate


A


B
Inferior labial artery


C


D

1] *Lip Shave*

When there is diffuse involvement of the lip by leukoplakia, the entire exposed surface may be excised readily Cosmetic and functional results following lip shave are excellent The procedure is done preferably with bilateral mandibular or mental block anesthesia, however, local infiltration with procaine or general anesthesia may be used

A —An incision is made for the full length of the lip exactly at the vermilion border If keratoses of the immediately adjacent skin are present, the incision may include a small strip of skin below the vermilion border

B —The mucosa of the entire exposed surface of the lip is undermined and elevated by sharp dissection The undermining is continued a sufficient distance beneath the mucosa on the inner side of the lip so that the wound can be closed readily after excision of the diseased portion

C —All the involved surface of the lip is trimmed away, leaving normal-appearing mucosa

D —The remaining mucous membrane is advanced and approximated to the skin edge with numerous interrupted sutures of fine silk A considerable amount of mucosa may be excised and the wound closed without undue tension

E —Lip cancers are frequently associated with diffuse leukoplakia of the lip When the cancer is small enough to be treated by a simple V excision, a lip shave may be performed at the same time for removal of the leukoplakia When the cancer is of sufficient size to require more extensive excision and plastic methods of repair, it is best to defer excision of any coexisting areas of leukoplakia

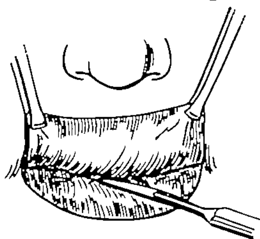
PLATE 31

A

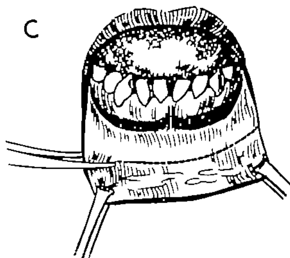


Incision

B



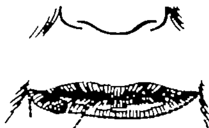
C



D



E



This procedure is of value when excision of one third or slightly more of the side of the lip is indicated It is also useful for correction of a short, tight lower lip following a too-extensive wedge excision

A—The incision around the lesion of the lower lip is outlined The length of lower lip to be removed is measured The flap of upper lip to be rotated should be one half this length so that ultimate loss of tissue from the upper and lower lip is approximately equal The upper rectangular flap is then outlined with methylene blue The medial point of the incision should end at least ⅛″ from the *vermilion* border of the upper lip, thus preserving the labial artery in the narrow pedicle of the flap

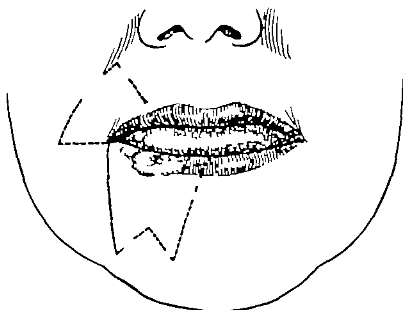
B—The excision of the lower lip is completed and hemostasis obtained The upper lip flap is raised by an incision through the full thickness of the lip, including mucosa, but carefully preserving the narrow medial pedicle The flap is rotated to rest in the lower lip defect The secondary defect in the nasolabial area is closed in layers

C—The flap is now fixed in place with interrupted sutures in the skin, muscle, and mucosa The vermilion borders must be aligned accurately

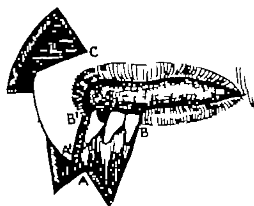
D—Much the same principle can be used for closure of defects of the mid-portion of the lower lip Following wedge excision of the middle third of the lower lip, a rectangular upper lip flap one half the length of the defect is elevated as above

E—An incision is carried downward and medially from the commissure of the mouth This allows the lateral portion of the lip to be moved medially to fill the central defect The upper lip flap is then rotated downward into the lateral defect and all the incisions are closed in layers

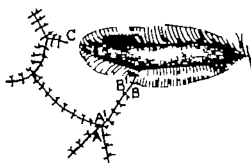
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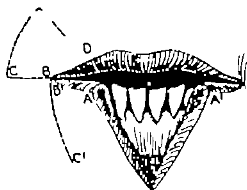
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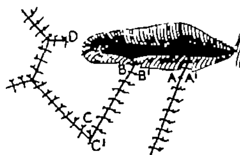
C



D



E



Abbe-Type Operation

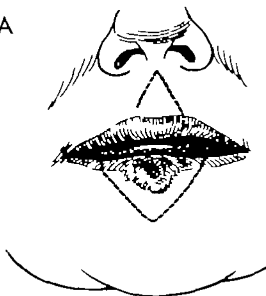
In this procedure, an operative defect of either the upper or lower lip is filled by a flap rotated from above or below The pedicle of the flap extends across the mouth so that it is necessary for the patient to be fed through a straw or glass drinking tube until the pedicle can be divided

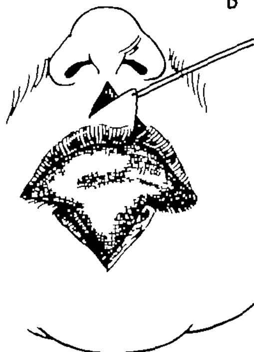
A —The proposed excision is outlined around the lesion with methylene blue A triangular flap of about one half the length of lip to be excised is drawn on the opposite lip One arm of this flap extends completely across the lip, the other stops just short of the vermilion-skin border

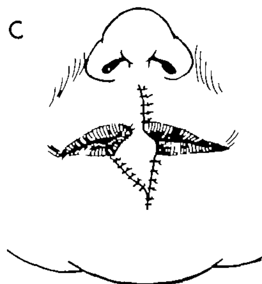
B —The lesion is excised The triangular flap consisting of the full thickness of the opposite lip is elevated and rotated into position

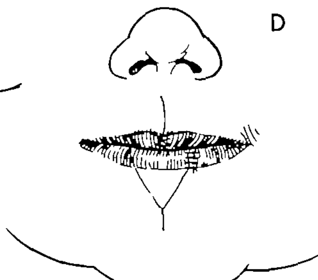
C —The wounds are closed by separate approximation of mucosa, muscle, and skin Sutures should not be placed too close to the narrow pedicle, since its blood supply must be preserved

D —After a waiting period of 3 weeks, the pedicle is divided The vermilion immediately adjacent to the site of the pedicle on the upper and lower lip is incised a short distance Small wedges of the exposed raw surface of the pedicle are excised, allowing repair of the vermilion and re-establishment of normal lip contour


A


B


C


D

Bernard-Type Operation

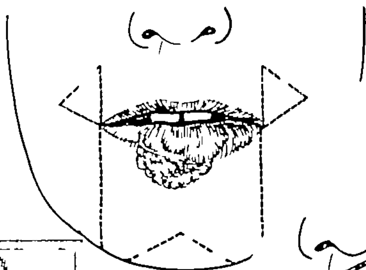
This procedure allows primary closure after excision of most or all of the lower lip Extensive lesions of the lower lip involving the skin of the chin may be excised by this method While the end result is satisfactory from a functional point of view, the patient has a typical expressionless lower lip

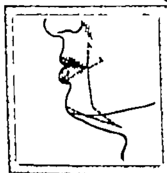
A—A rectangular type of incision is made around the lesion of the lip The vertical arms of the incision are carried down over the skin of the chin The wedged base of the excision extends to the submental region Small triangles are outlined adjoining the commissures of the mouth The base of each triangle is in line with the lower lip and half as long as the expected defect The apex lies in the nasolabial fold

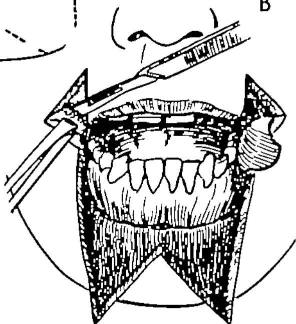
B—The block of tissue containing the full thickness of the lower lip and skin of the chin is excised and hemostasis is obtained The triangular nasolabial incisions are made The skin, subcutaneous tissue, and muscle are excised and discarded The mucosa of the triangle is preserved The mucosal attachment of the base of the triangle is preserved and the sides are incised to form a flap of mucous membrane

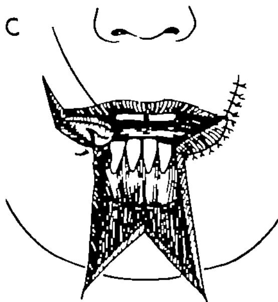
C—The flaps of mucosa are turned outward and approximated to the skin with fine interrupted sutures to form a new vermilion border Excising a small triangle of skin at the corner of the mouth will allow better adjustment of the mucosal flaps

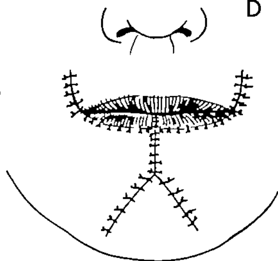
D—The tissues of the cheek and chin are now shifted medially, closing the two nasolabial triangles and filling the operative defect Mucosa, muscle, and skin are approximated separately with interrupted sutures


A




B


C


D

CHAPTER 8

The Mouth and Pharynx

THE SURGICAL TREATMENT of most benign lesions of this region is quite simple It is important to recognize these conditions and to carry out adequate therapy because a number of them, particularly leukoplakia and epithelial papillomas, are well-known precursors of cancer Mixed tumors and other benign neoplasms arising in minor or ectopic salivary glands in the oral cavity also have a malignant potential Removal of other lesions, including lipomas, hemangiomas, myoblastomas, granulomas, and epithelial cysts, is indicated because of cosmetic deformities produced, or because of their interference with normal speech, mastication, or deglutition Most benign tumors may be excised with the use of local infiltration or regional block anesthesia

MALIGNANT TUMORS

Most cancers of this region are epidermoid carcinomas The grade of malignancy generally increases with involvement of the posterior portion of the oral cavity and pharynx Cancers of the anterior tongue, gum, or floor of the mouth are usually of a low grade of malignancy, while tumors of the tonsil, base of tongue, and pharyngeal wall tend to be anaplastic and more aggressive in their clinical behavior Other malignant tumors arising in this area include melanomas, malignant lymphomas, sarcomas, and adenocarcinomas

A phenomenon which has not received the attention it deserves is the frequent presence of premalignant changes in grossly

normal appearing mucosa around an epidermoid carcinoma of the mouth. Microscopic examination of the normal appearing mucous membrane will reveal multiple foci of dyskeratosis and in-situ cancer. This finding has been described by Slaughter and Southwick* as "field cancerization" and is responsible for many treatment failures and for the appearance of multiple separate cancers of the oral cavity. We have treated 1 patient for 7 separate primary cancers which in a 9-year period developed on the tongue, gingiva, buccal mucosa, and floor of the mouth.

Both surgery and radiotherapy play a part in the management of cancers of the mouth and pharynx. Although this is a surgical handbook, mention of radiotherapy cannot be omitted, for the surgeon treating tumors in this region must be aware of both the advantages and disadvantages of irradiation. He may also be called on to aid the radiotherapist in the insertion of radium needles or gold filtered radon seeds.

Radiotherapy

A variety of modalities of ionizing radiation are used in the treatment of malignant tumors of the oral cavity and pharynx. X-ray therapy is administered by peroral cones directed at the lesion or by external ports directed through one or both sides of the cheek or neck. The greatest experience has been accumulated with fractionated doses of high voltage x ray in the 200-250 kv range. In recent years the use of higher-energy irradiation ranging from 400 kv. to 1,000,000 volts has resulted in less skin reaction, less damage to bone and normal tissues, and improvement in the control of certain tumors. External irradiation with "bombs" of radioactive cobalt is also used and is equivalent to irradiation from 2,000,000-volt equipment. Surface irradiation by radium molds applied to tumors of the oral cavity has been used extensively, particularly in England. Interstitial irradiation is used in the treatment of both the primary tumor and its metastatic deposits. It has been achieved with radium needles, gold filtered radon seeds, and more recently with a variety of radioisotopes.

* Slaughter, D. P., Southwick, H. W., Smejkal, W.: "Field cancerization" in oral stratified squamous epithelium, Cancer 6:963-968, 1953.

] *Radiotherapy*

Radiotherapy of cancer of the oral cavity and pharynx has a number of limitations It is generally ineffective in the treatment of adenocarcinomas, sarcomas, and melanomas It is usually contraindicated for cancers overlying or invading bone because of the sequelae of osteoradionecrosis As a rule, it should not be used for recurrent cancer in an area previously subjected to heavy irradiation Precancerous leukoplakia adjacent to a cancer is often incompletely eradicated by irradiation and remains as a threat of further malignant change It should also be emphasized that although radiotherapy may be effective in controlling a primary lesion in the mouth, it is far less effective than surgery in the management of metastatic epidermoid cancer in cervical lymph nodes In recent years, we have been reluctant to advise the use of irradiation for young patients in whom surgical treatment of the tumor is feasible because of the possibility of serious late irradiation changes including postirradiation cancer in the skin and soft tissues and postirradiation osteogenic sarcoma of bone

Radiotherapy should be used mainly in the treatment of malignant lymphomas in this area and the management of certain selected epidermoid carcinomas Early, superficial cancers, particularly those in relatively inaccessible portions of the oral cavity, are satisfactorily treated by irradiation In such sites as the soft palate, there is less disturbance to function following irradiation than after surgical excision

A point which deserves more emphasis than it has received is the fact that radiotherapy should not be thought of as the treatment of choice for the more advanced cancers of the mouth and pharynx Failure of carefully administered irradiation to control these bulky and deeply infiltrating tumors has influenced us and others to rely more often on an aggressive surgical attack which has frequently been rewarding Radiotherapy has not only failed to control such cancers but has often failed to achieve any palliation, in fact, the patient's existence may become more miserable because of the reaction to the irradiation in the tumor and the surrounding tissues This is not to deny, however, that small doses of x-ray may achieve considerable palliation in some advanced and inoperable cancers by clearing up secondary infection and reducing the bulk of the tumor mass

The choice of irradiation or surgical therapy for cancer in different locations of the mouth and pharynx is often a controversial subject. It depends on the histology of the tumor, its bulk, its accessibility, and its encroachment on neighboring structures, particularly bone. The accompanying table expresses in general our opinion as to the choice of therapy for epidermoid carcinomas in various anatomic locations. The table should not be considered to apply invariably to each case encountered, since any of the factors previously mentioned may have a determining influence on the type of treatment ultimately chosen.

Site of Epidermoid Carcinoma	Treatment of Choice
Tongue (anterior ⅔)	Surgery
Tongue (base)	Surgery
Gum	Surgery
Floor of mouth	Surgery
Buccal mucosa	Irradiation or surgery
Hard palate	Surgery
Soft palate	Irradiation
Tonsil	Irradiation or surgery
Pharyngeal wall	Irradiation

Radiotherapy preferred for early or superficial lesions; surgery indicated for more advanced, deeply infiltrating fixed lesions.

Some tumors demand surgical extirpation for control, others are more efficiently managed by radiotherapy. In other situations either mode of therapy may be satisfactory and the decision will depend more on the experience and preference of the physician. A mistake occasionally made is to withhold surgery when it is indicated and resort to radiotherapy because of the age or general condition of the patient. Radiotherapy administered for cure of cancer of the mouth and pharynx has a morbidity approximately equal to that of surgery.

Surgical Treatment

Melanomas, sarcomas, adenocarcinomas, and most epidermoid carcinomas of the oral cavity are best managed surgically. The essential of surgical treatment is adequate local excision of the primary tumor. This includes a wide excision of normal mucosa around the lesion and a deep excision of underlying tissues. In

cision into the tumor or across deep extensions of the tumor is followed by prompt recurrence During operative procedures, the surgeon must be ever mindful of the danger of spilling tumor cells into the wound Clamps must not be placed across the neoplasm, and rough manipulation should be avoided Following excision, and before repair of the wound, thorough irrigation of the tissues with sterile saline is carried out When the tumor adjoins or overlies bone, the surgeon must not hesitate to resect an adequate amount of bone (see Chapter 10) At times, removal of a small segment of the alveolus or palate is required More extensive lesions with actual infiltration of bone may require removal of the entire maxilla or hemi-mandible

In the past, cautery has been used extensively for the destruction of intra-oral cancer Its use was followed by delayed healing, discomfort, infection, and often extensive scarring and distortion of tissues We believe that this technic has little place in the present-day management of these tumors Excision with the scalpel, followed by careful wound repair, accomplishes more adequate control of the neoplasm and more satisfactory recovery of function

Lesions in the anterior portion of the oral cavity usually may be excised through the open mouth Less accessible lesions require exposure by reflection of an upper cheek flap (Fergusson) or a flap formed by dividing the lower lip and skin of the chin in the midline Occasionally, the body of the mandible must be divided and retracted for access to a lesion of the base of the tongue or tonsil

Surgical treatment of small superficial malignant tumors of the oral cavity is followed by minimal functional or cosmetic disturbance Wide block resections necessitated for the control of more advanced infiltrating lesions result in disturbances in deglutition, speech, and appearance which may be minor or severe These difficulties are at their worst during the first few weeks after surgery A surprising degree of adaptation to the distorted anatomy, with recovery of function, will then occur in most patients The segment of tongue remaining after a hemiglossectomy, for example, shifts toward the midline The swallowing mechanism becomes efficient with time and practice, and speech improves Most of the

patients are elderly and accept a moderate degree of external deformity or loss of contour without complaint so long as they are comfortable and able to talk and eat While management of the functional and cosmetic disturbances following removal of extensive tumors may at times be a problem, it is far less distressing than the more difficult task of caring for the patient with uncontrolled intra-oral cancer

The procedures described in this chapter illustrate methods of local excision of tumors of the oral cavity Cervical lymph node metastases from intra-oral lesions because of their extent and location are managed by combined and in-continuity excisions with radical neck dissections The indications and technics for these procedures are presented in Chapter 14

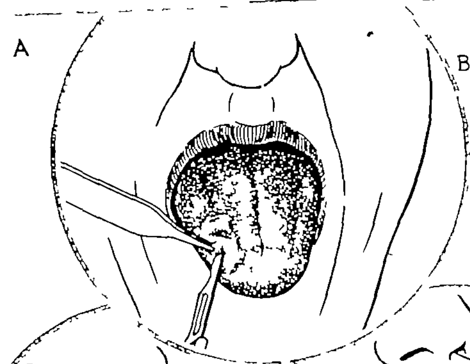
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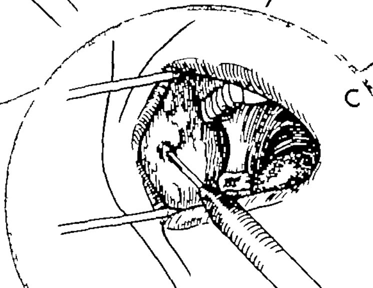
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PLATE 35



B

Excision of isolated leukoplakia



Electro-desiccation of diffuse leukoplakia

Management of Leukoplakia of the Oral Cavity

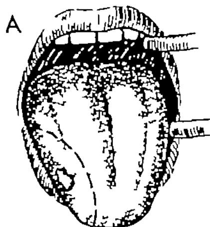
Leukoplakia of the oral cavity is a known precancerous condition The lesions may occur as discrete white plaques or as diffuse filmy changes over large areas of mucous membrane In the treatment of leukoplakia, certain general nonsurgical measures may be successful Foremost among these is the removal of any source of chronic irritation which may be causing or aggravating the condition Dental hygiene should be improved, ragged tooth fragments extracted, and poorly fitting dentures corrected Areas of leukoplakia may regress or entirely disappear if the patient can be persuaded to stop smoking or chewing tobacco Vitamin preparations containing A and B complex are often useful Syphilis is frequently associated with oral leukoplakia, but must be ruled out as a possible cause

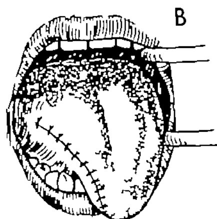
A —Thickened hypertrophic patches and fissures or ulcers in areas of leukoplakia should lead one to suspect a malignant change Such areas should always be biopsied A portion of the involved mucosa is removed with a sharp biopsy forceps or scalpel and microscopic sections examined before further treatment is undertaken

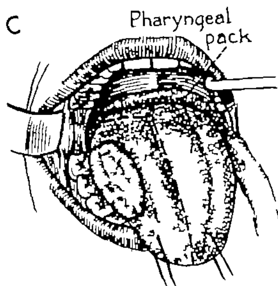
B —Small isolated patches of leukoplakia may be excised under local infiltration or regional nerve block anesthesia A commonly involved area which may be so treated is the buccal mucosa near the commissure of the lips The margins of the excision need be only a few millimeters from the lesion and the excision carried no deeper than the mucous membrane Primary closure with a few interrupted sutures of fine silk is almost always possible

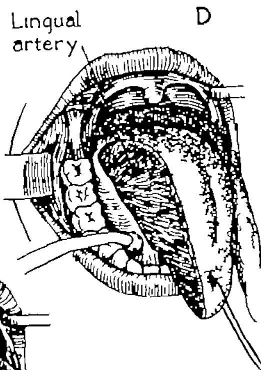
C —Larger areas of leukoplakia which cannot be excised readily may be treated by electrodesiccation, using local or general anesthesia following biopsy The involved mucosa should be superficially fulgurated The patient is treated with frequent saline sprays and oral irrigations until separation of the devitalized tissue has taken place and re-epithelization occurs Leukoplakia may recur in areas thus treated and necessitate further therapy

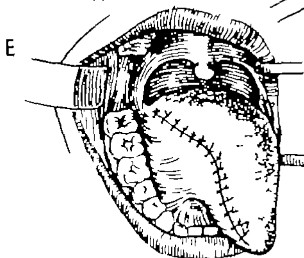
Diffuse areas of filmy leukoplakia may be treated by the nonsurgical measures outlined above The patients should be examined at regular intervals, however, and biopsies taken of any suspicious areas which may appear


A


B


C
Pharyngeal pack


Lingual artery
D


E

)] *Partial Glossectomy; Hemiglossectomy*

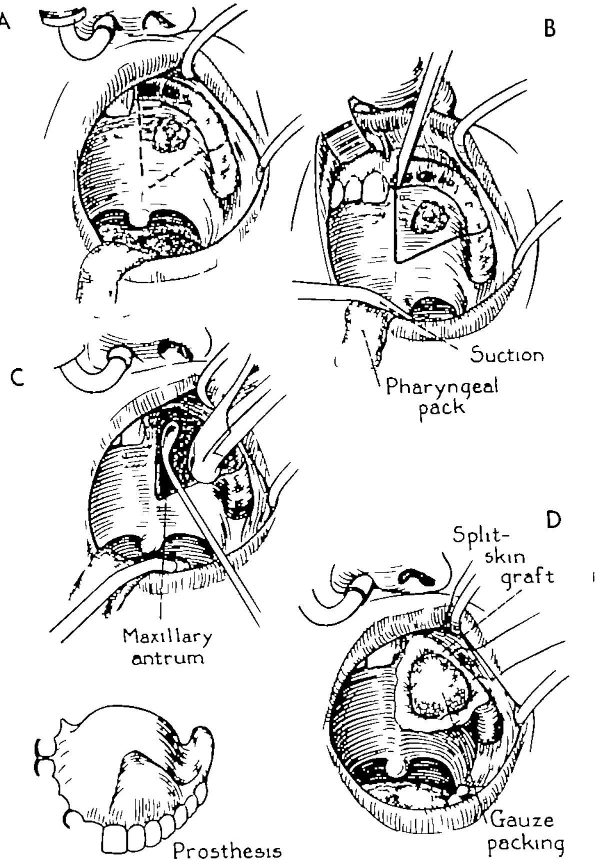
A—Benign lesions of the tongue and small superficial cancers on the edge of the tongue may be excised readily Mandibular nerve block or general endotracheal anesthesia is used The mucosal incision is outlined with a scalpel and the underlying muscle divided with dissecting scissors Bleeding vessels are clamped and tied or transfixed with fine chromic sutures

B—The wound in the tongue is closed with interrupted sutures of 4-0 silk

C—Many of the more extensive tumors of the tongue may be treated by a hemiglossectomy Endotracheal anesthesia is necessary and a pharyngeal pack of moist gauze should be inserted at the start of the operation A traction suture of heavy silk is placed near the tip of the tongue on each side A mouth gag and cheek retractor aid in exposure

D—Starting anteriorly, the tongue is divided in the midline to or beyond the circumvallate papillae The mucosal incision on the dorsum of the tongue is made with a scalpel The mucosa on the undersurface of the tongue is then incised, and scissors used to divide the musculature Few vessels pass across the midline of the tongue and only moderate bleeding will be encountered The incision is then carried across the tongue posteriorly on the involved side well back of the tumor The lingual artery and several of its branches will be encountered and must be clamped and secured with sutures of 3-0 chromic catgut The field is kept as dry as possible with the use of a metal suction tip during the procedure An incision in the mucosa of the floor of the mouth is carried from the midline anteriorly around the tongue to the anterior tonsillar pillar posteriorly to meet the incision across the posterior portion of the tongue, completing the excision

E—After adequate hemostasis has been secured, the wound is closed with interrupted sutures of 4-0 silk The mucosa of the dorsum of the tongue posteriorly is sutured to the floor of the mouth Anteriorly, the mucosa of the dorsal and ventral surfaces of the tongue are approximated The remnant of tongue is held in a normal mid-position during placing of the sutures, to avoid distortion


A
B
Suction
Pharyngeal pack
C
Maxillary antrum
D
Split-skin graft
Prosthesis
Gauze packing

Excision of Cancer of the Hard Palate

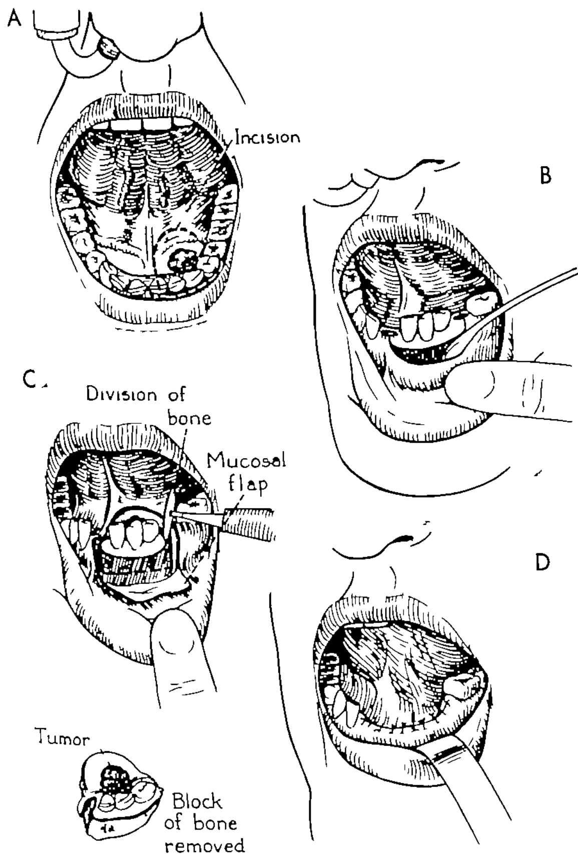
Because of their proximity to bone and the likelihood of bone invasion, tumors of the hard palate and upper alveolus should be treated surgically Adequate removal of most of these lesions necessitates entry into the maxillary antrum The mucosal lining of the antrum should be removed and examined for involvement by tumor Small and readily accessible lesions of the upper alveolus or palate may be resected through an oral approach, as indicated More advanced tumors require the additional exposure afforded by the Fergusson incision (Chapter 9) When the antrum has been invaded, resection of the entire maxilla is the most satisfactory treatment

A —Endotracheal anesthesia is secured and a pharyngeal pack inserted An incision through the mucosa of the gum and hard palate is outlined well away from the tumor Teeth occupying the proposed line of resection are extracted

B —A mallet and chisel are used to divide the upper alveolus and palate in line with the mucosal incision The tumor and underlying bone are resected en bloc

C —The maxillary antrum is explored and its mucosal lining removed with curettes A number of curettes of different sizes with malleable handles are required to deal with all inner surfaces of the antrum A rongeur is used to remove all sharp edges and bony projections from the opening into the antrum

D —If the opening into the antrum is large enough, the antrum may be lined with a split-skin graft held in place with gauze packing Otherwise, the antrum is packed with plain or iodoform gauze The packing is removed on the 6th postoperative day and a temporary obturator prepared to close the opening into the antrum, allowing the patient to speak and eat normally This is replaced by a permanent obturator in 4-6 weeks, when wound healing is complete


A
Incision
B
C
Division of bone
Mucosal flap
D
Tumor
Block of bone removed

4] *Excision of Cancer of the Lower Gingiva*

The procedure illustrated is applicable to early superficial lesions of the lower gingiva and adjacent floor of the mouth More advanced infiltrating lesions which have invaded bone or metastasized to cervical lymph nodes require the combined operative procedure described in Chapter 14, which includes resection of the mandible and radical neck dissection It must be emphasized that bone invasion may be present even though it may not be demonstrated by roentgenogram Any lesion which is fixed to bone or ulcerating into bone must be considered as invading bone and is not suitable for the local excision described here

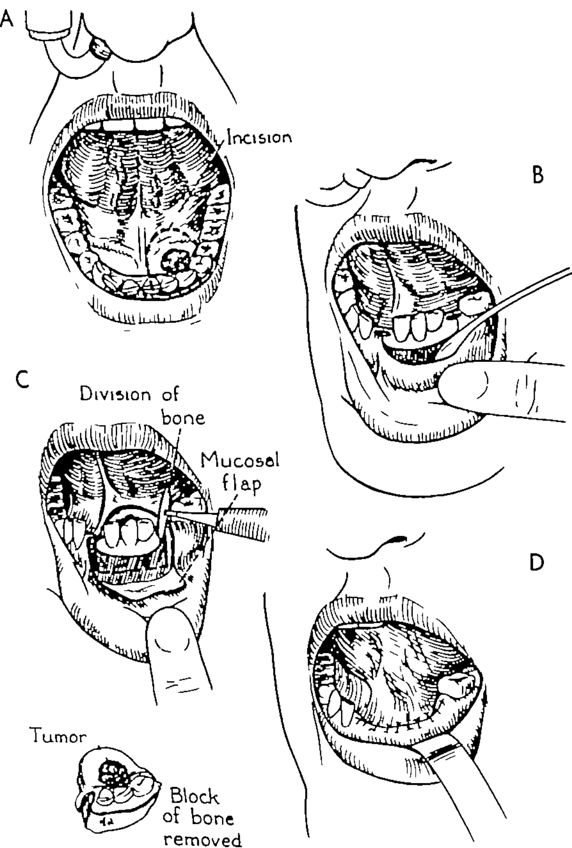
A —Nasal endotracheal anesthesia is secured and a pharyngeal pack of moist gauze inserted An incision is outlined in the floor of the mouth and across the gum around the tumor, leaving an intervening margin of at least 1 5-2 cm of normal mucosa

B —A periosteal elevator is used to expose the outer surface of the mandible Flaps of normal mucosa are elevated beyond the outlined incision so that more bone may be resected than mucous membrane Teeth occupying the proposed line of resection are extracted

C —A bone saw or mallet and chisel are used to free the segment of mandible adjacent to the tumor A sizable block of bone is removed Wharton's duct often must be transected and ligated as the excision proceeds around the tumor in the floor of the mouth

D —Primary closure is often possible by approximation of the mucosa of the floor of the mouth to the mucosa of the gingivolabial sulcus across the exposed segment of mandible Interrupted sutures of 4-0 silk are used A larger defect requires coverage with a split-skin graft applied directly to bone and held in place with a stent of gauze and molded dental compound Following wound healing, the trough in the alveolar ridge can be compensated for by an appropriate section or block on a dental prosthesis

PLATE 38


A
Incision
B
C
Division of bone
Mucosal flap
D
Tumor
Block of bone removed

Excision of Cancer of the Buccal Mucosa

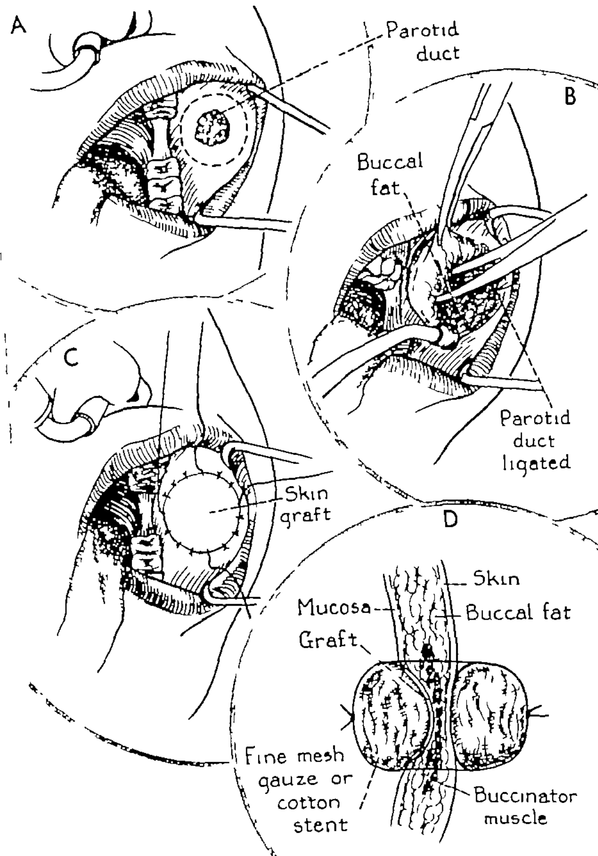
Superficial cancers of the buccal mucosa may be treated by surgical excision or irradiation Radiotherapy is accomplished by external irradiation through lateral cheek and peroral fields or by the use of interstitial radiation with gold filtered radon seeds Radiotherapy is less likely to succeed when the tumor extends to adjacent bone or when an infiltrating tumor involves the full thickness of the cheek With bone invasion, the involved area of bone is resected with the tumor Deeply infiltrating tumors may require full-thickness excision of the cheek and secondary closure with a flap or tubed pedicle (Chapter 6) The procedure illustrated is performed for a typical "verrucous" carcinoma often seen in patients who chew tobacco

A—Nasal endotracheal anesthesia and a pharyngeal pack are required An incision is carried through normal mucosa at least 1 5 cm around the tumor A metal suction tip is used to aspirate blood and to facilitate exposure

B—Dissection is carried deeply beneath the tumor into the buccal fat pad Any suspicion of tumor extension into this area should be investigated by immediate frozen section The orifice of the parotid duct is involved by cancer in this patient The duct must be identified in the deep dissection, divided, and ligated with fine silk Failure to ligate the duct will result in loss of the skin graft by parotid secretions accumulating beneath it The parotid swelling which occurs following duct ligation is transient, and these patients have not complained of undue dryness of the mouth

C—Bleeding vessels are secured with ties of fine chromic catgut A split-thickness skin graft is applied to the raw surface and sutured to the surrounding buccal mucosa with numerous interrupted sutures of fine silk

D—The graft is covered with a small pack of fine-mesh gauze or cotton Fixation is secured by passing sutures of silk or fine wire around the pack and through the full thickness of the cheek to be tied around an external gauze stent The size of the graft is considerably reduced by scarring in the months following surgery, but this has seldom interfered with the cosmetic or functional result


A
Parotid
duct
B
Buccal
fat
Parotid
duct
ligated
C
Skin
graft
D
Skin
Mucosa
Buccal fat
Graft
Fine mesh
gauze or
cotton
stent
Buccinator
muscle

] **Radon Seed Insertion**

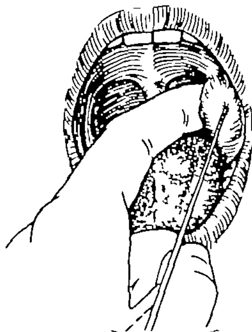
Gold filtered radon seeds are an effective method of administering interstitial irradiation to cancers of the oral cavity and pharynx The gold seeds may be used alone or in combination with external irradiation Because of the high doses of irradiation immediately around each seed, it is seldom necessary to use seeds of more than 0 5 or 1 millicurie each The seeds should not be placed immediately adjacent to bone, since osteoradionecrosis will result

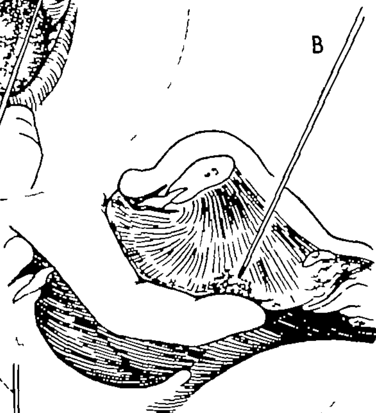
A —The gold seeds may be inserted directly into the tumor through the mouth Implantation of a cancer of the tonsil is illustrated An estimation of the bulk and extent of the lesion is obtained by inspection and palpation Surface anesthesia is accomplished by topical application of 10% cocaine Sharp gold seed implanters are inserted in and around the tumor, being guided by a palpating finger An attempt should be made to establish an even pattern of seeds throughout the tumor The seeds should be no closer than 1 0 cm to one another and no farther apart than 1 5 cm The more superficially placed seeds should be about 5 mm below the mucosal surface

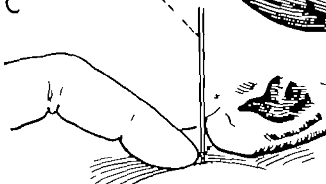
B —Radon seeds may be most efficiently inserted in the base of the tongue via an external approach The pharnyx and base of the tongue are anesthetized with topical cocaine A small area of skin in the midline of the suprahyoid region is infiltrated with 1% procaine and a 5 mm skin incision made with a pointed scalpel A finger is placed on the tumor of the base of the tongue and the seed inserters are injected above the hyoid bone directly to the base of the tongue The pattern and depth of seed insertion is directed by the palpating finger

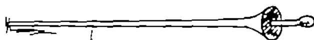
C —Radon seeds are of occasional value in the management of bulky nonresectable metastases to cervical lymph nodes Wheals of procaine are raised in the skin overlying the node and small stab wounds through the skin made with a pointed scalpel One hand of the operator holds the node and the other injects the gold seeds Several seed inserters may be left in situ during this procedure to aid in determining the pattern of seeds being placed Roentgenograms taken in two planes are also of aid in evaluating seed distribution

PLATE 40









CHAPTER 9

The Nasal Cavity, Nasophyarnx, and Paranasal Sinuses

THE COMMONLY SEEN benign tumors of this region are mucosal polyps, which generally arise on narrow pedicles from the middle turbinate or the upper posterior part of the nasal cavity Usually, they may be removed without difficulty with a snare, using topical anesthesia A far less common but potentially more serious benign neoplasm is the juvenile nasopharyngeal angiofibroma This tumor is seen most often in male children and adolescents and generally arises from the nasopharynx or the posterior nasal choanae It can grow to large size, distorting the features, and spontaneous hemorrhage may be alarming At times, smaller tumors may be removed with a snare of heavy wire introduced through the nose or mouth Larger tumors with serious hemorrhage may require a transantral approach to the nasopharynx, utilizing the Fergusson incision Hormonal therapy has also been used, since sexual maturity in these boys may be accompanied by tumor regression Radiotherapy is generally not indicated

Malignant tumors arising primarily in the nasal cavity are quite rare and usually are best managed by radiotherapy The nasal cavity is more often involved by extension of cancers originating in the paranasal sinuses, the nasopharynx, or the skin of the nose In such instances, a surgical or a combined approach of radiotherapy and surgery may become indicated

Cancers of the accessory sinuses, particularly the antrum, are

more commonly seen than those of the nasal cavity Diagnosis of a neoplasm of the sinuses is frequently delayed because of the paucity of early signs and symptoms of a malignant tumor in this region. Frequently the diagnosis becomes apparent only when there has been extension of the disease into the orbit the nasal cavity or through the palate Tissue diagnosis must be established by biopsy of the mass at a point to which it has extended or by direct biopsy of the antrum through the canine fossa Most tumors of the sinuses are squamous cell carcinomas however malignant lymphomas adenocarcinomas and undifferentiated malignant tumors are also encountered.

We favor a primary surgical approach for the treatment of cancers of the paranasal sinuses This consists of removal of the entire maxilla containing the intact antrum followed by destruction of the ethmoid air cells and curettage of the sphenoid sinus Depending on the location and extent of the tumor surgery is frequently followed by external radiotherapy or radium application. Cervical lymph node metastases have been uncommon and radical neck dissection is indicated only in the presence of clinical or biopsy evidence of metastatic spread

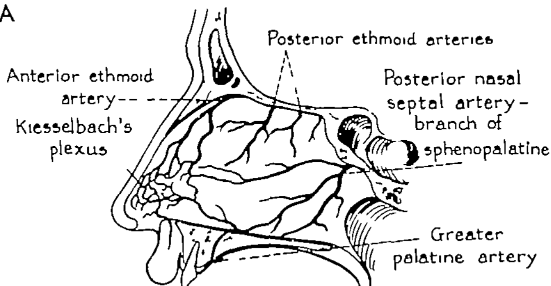
An early diagnosis is also unusual in cancers arising in the nasopharynx The first sign of disease in this region is often metastasis to the upper jugular lymph nodes Whenever metastatic cancer is discovered in the upper jugular chain and no primary tumor is evident, the nasopharynx must be examined carefully and repeatedly using a nasopharyngeal mirror as well as a nasopharyngoscope The treatment of cancer of the nasopharynx is by external irradiation which may be combined with local radium or radon application Since these tumors are usually quite radiosensitive cervical metastases often may be controlled also by radiotherapy On rare occasions radical neck dissection becomes necessary

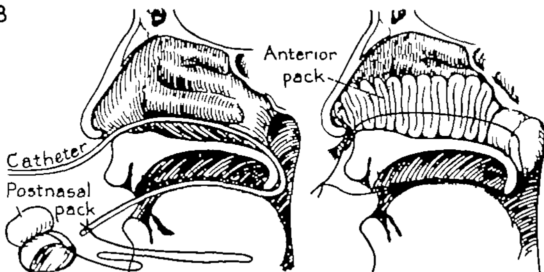
Nasal hemorrhage may result from a large variety of causes, including trauma, infection, neoplasm, elevated arterial or venous pressure, and disorders of the blood-clotting mechanism There is also a hereditary form of epistaxis due to hemorrhagic telangiectasia (Rendu-Osler-Weber disease) Nasal hemorrhage is usually mild and self-limited At times, the general surgeon is called on for its control

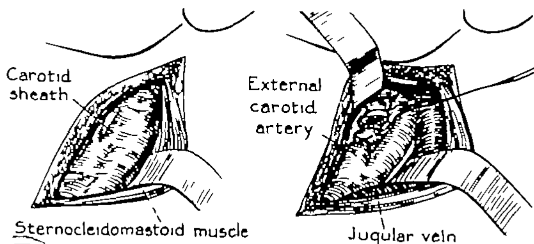
A—The commonest site of bleeding is a readily accessible point on the anterior inferior aspect of the nasal septum where several anastomosing groups of vessels are located superficially in the mucosa (Kiesselbach's area) Bleeding here may be controlled by direct pressure with a small pack of Oxycel or Gelfoam If a single bleeding point is visualized, it may be cauterized with a silver nitrate bead or coagulated superficially with the electrocautery

B—In elderly patients with arterial hypertension, the bleeding may originate from branches of the sphenopalatine artery around the middle turbinate or from sphenopalatine and ethmoidal vessels in the attic of the nose Bleeding from these areas may require a posterior as well as an anterior nasal pack A small rubber catheter is introduced through the nostril on the side of the hemorrhage, is grasped in the pharynx, and drawn through the mouth A gauze pack about 3×2×2 cm in size is tied to the midpoint of a heavy silk suture The end of the suture is attached to the catheter and drawn out through the nose and the pack pulled securely into the postnasal area The ends of the suture protruding through the nose and the mouth are then anchored to the cheek with adhesive tape and an anterior pack of petrolatum gauze inserted in the nasal cavity The packs are removed in 24-28 hours

C—On rare occasions, ligation of one or both external carotid arteries may be resorted to for intractable bleeding The carotid bifurcation is exposed by an incision along the anterior margin of the sternocleidomastoid muscle The muscle is retracted, the carotid sheath entered, and the external carotid identified The artery should be ligated with heavy silk, divided, and the cut ends transfixed Even this procedure may fail to control bleeding from the ethmoidal vessels which come from the internal carotid via the ophthalmic artery Ligation of the internal or common carotid is not justified because of the serious risk involved


A
Posterior ethmoid arteries
Anterior ethmoid artery
Posterior nasal septal artery - branch of sphenopalatine
Kiesselbach's plexus
Greater palatine artery


B
Anterior pack
Catheter
Postnasal pack


C
Carotid sheath
External carotid artery
Sternocleidomastoid muscle
Jugular vein

Exploration and Drainage of the Maxillary Antrum

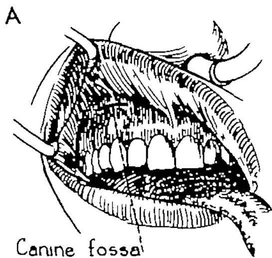
The maxillary antrum must be entered, explored, drained, or packed at various times in the management of malignant tumors, infections, and fractures Antrotomy by forming a window in the naso-antral wall of the inferior meatus in the treatment of chronic suppurative sinusitis is a technic often used by otolaryngologists For the purposes of the general surgeon, the external approach illustrated is preferable The Caldwell-Luc operation consists of the external approach plus the construction of a naso-antral window beneath the inferior turbinate

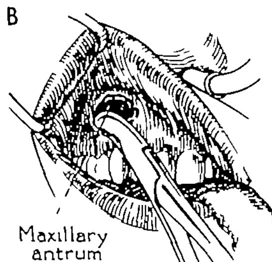
A —Endotracheal anesthesia or local infiltration is used The upper lip is elevated and a transverse incision is made in the gingivolabial sulcus centered above the canine tooth The incision is carried directly down on the underlying bone

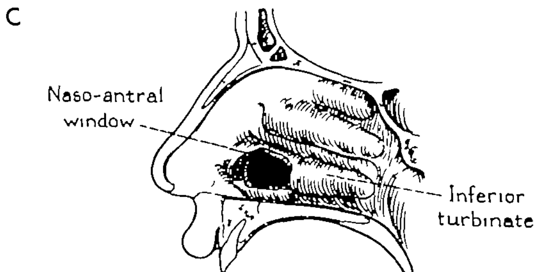
B —A periosteal elevator is used to elevate the periosteum and soft tissues away from the anterior surface of the maxilla around the canine fossa The thin bony plate in this region is perforated with a gouge and the antrum entered The opening is enlarged with a rongeur until the interior of the antrum may be visualized and digitally explored If further exposure is needed, the anterior angle of the sinus may be opened by extending the bony window medially through the thicker bony bridge between the canine fossa and the piriform aperture of the nose The mucous membrane lining of the antrum is removed with angled curettes

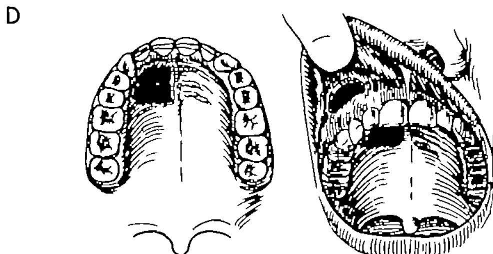
C —Naso-antral drainage may be established by removing a portion of the naso-antral wall below the inferior turbinate, using cutting forceps and rasps

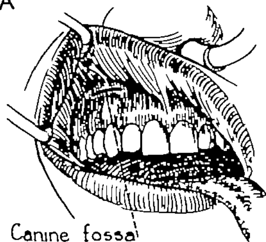
D —Permanent communication between the oral cavity and antrum may be accomplished by removing a portion of the hard palate and alveolar ridge This is occasionally indicated to permit intracavitary radiation of the antrum, to facilitate careful follow-up examinations for tumor recurrence, or to establish adequate drainage of a necrotic tumor A chisel is used to resect the palate in the area opposite the central incisor and the first molar The edges of the opening are trimmed with a rongeur The antrum is packed with plain or iodoform gauze at the conclusion of the operation After removal of the packing, a dental prosthesis with an obturator serves to close the palatal defect

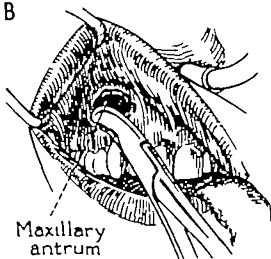

A
Canine fossa

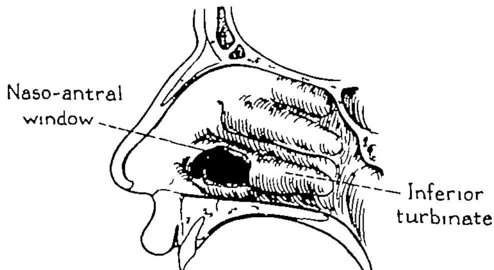

B
Maxillary antrum

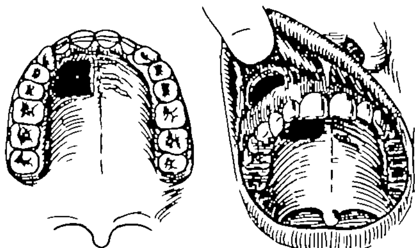

C
Naso-antral window
Inferior turbinate

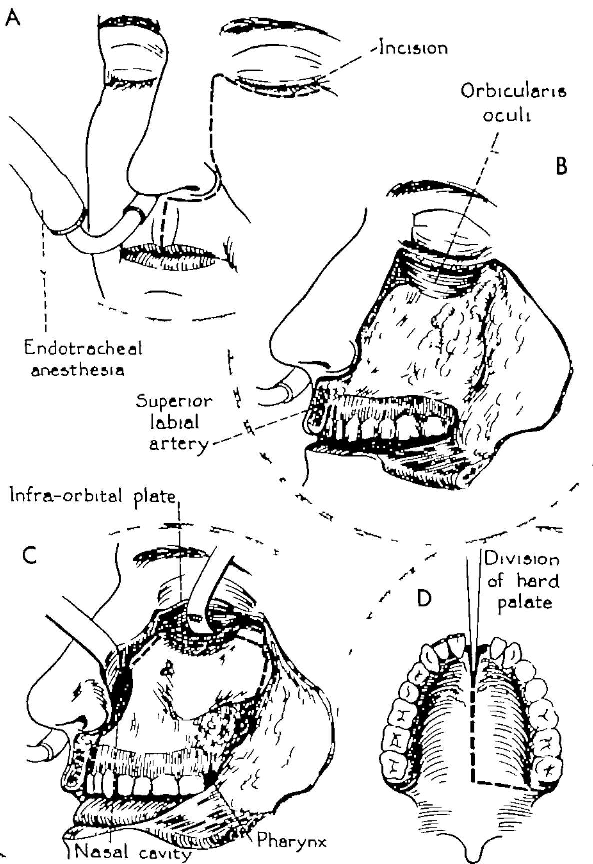

D

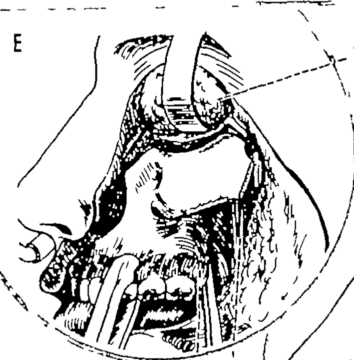

A
Canine fossa


B
Maxillary antrum

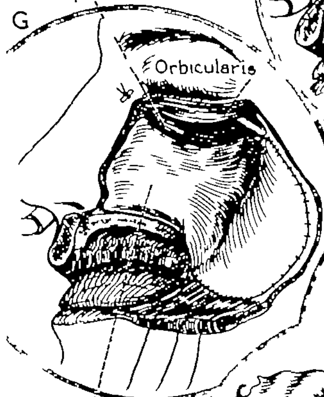

C
Naso-antral window
Inferior turbinate

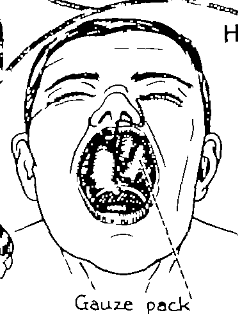

D

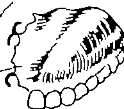

A
Incision
Orbicularis
oculi
B
Endotracheal
anesthesia
Superior
labial
artery
Infra-orbital plate
C
Division
of hard
palate
D
Nasal cavity
Pharynx


E
Periorbital fat
Tuberosity of maxilla
Temporalis muscle


Ethmoid air cells
Temporalis muscle
Sphenoid sinus
F
Nasal septum
Nasopharynx


G
Orbicularis
Skin graft
Prosthesis


H
Gauze pack



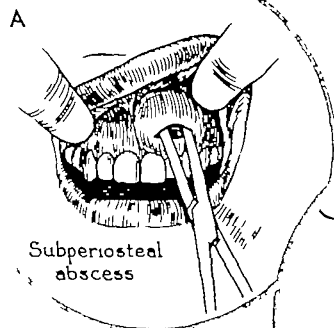
coma The diagnosis is made by roentgen study and by open biopsy Treatment varies from conservative local excision or segmental resection for benign tumors to removal of the entire mandible or maxilla for osteogenic sarcoma

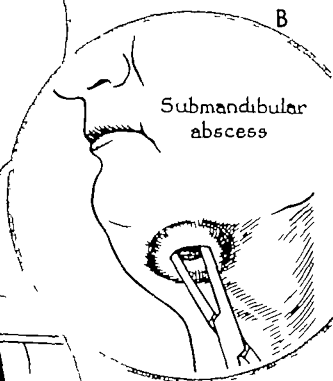
It is frequently necessary to resect bone in the surgical treatment of head and neck cancer The primary lesion may originate in mucosa immediately over bone (i e cancer of gums hard palate, antrum) or may extend to involve bone Cervical lymph node metastases in the submandibular region may also erode the adjacent mandible Considerable judgment is required in deciding how extensive a resection of the jaws is indicated In the case of tumors which merely overlie bone or invade the periosteum a wide local excision of the adjacent plate of bone is usually sufficient (see Chapter 8) Segmental resection of the mandible may be required for other intra-oral cancers with limited bone erosion If there is likelihood that the tumor has invaded the medullary canal, the entire hemi mandible must be resected Byars* has emphasized that this occurs particularly in elderly and edentulous patients in whom the medullary canal becomes progressively more exposed and vulnerable near the upper surface of the mandible Resection of the entire maxilla is performed in the treatment of many tumors arising in the antrum (see Chapter 9)

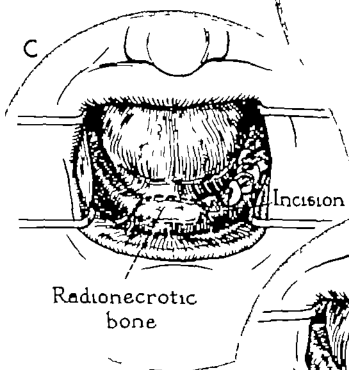
Radiographic evidence of bone invasion is often lacking until extensive destruction of bone has occurred. Although it is important to secure roentgenograms of the jaws when there is an adjacent neoplasm, the surgeon's decision to preserve bone or to perform a conservative bone excision must be based on clinical judgment rather than on negative roentgen findings A careful clinical estimate of fixation of tumor to bone and ulceration into bone is generally a reliable guide to bone involvement.

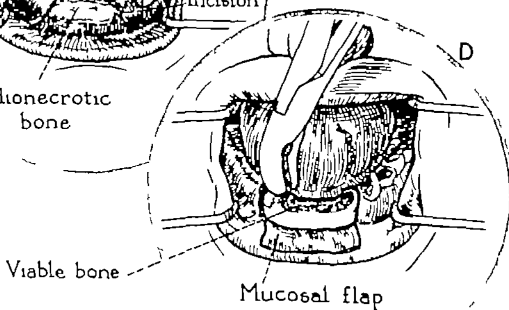
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* Byars, L T Extent of mandibular resection required for treatment of oral cancers, A M A. Arch. Surg 70 914 922, 1955


A
Subperiosteal
abscess


B
Submandibular
abscess


C
Incision
Radionecrotic
bone


D
Viable bone
Mucosal flap

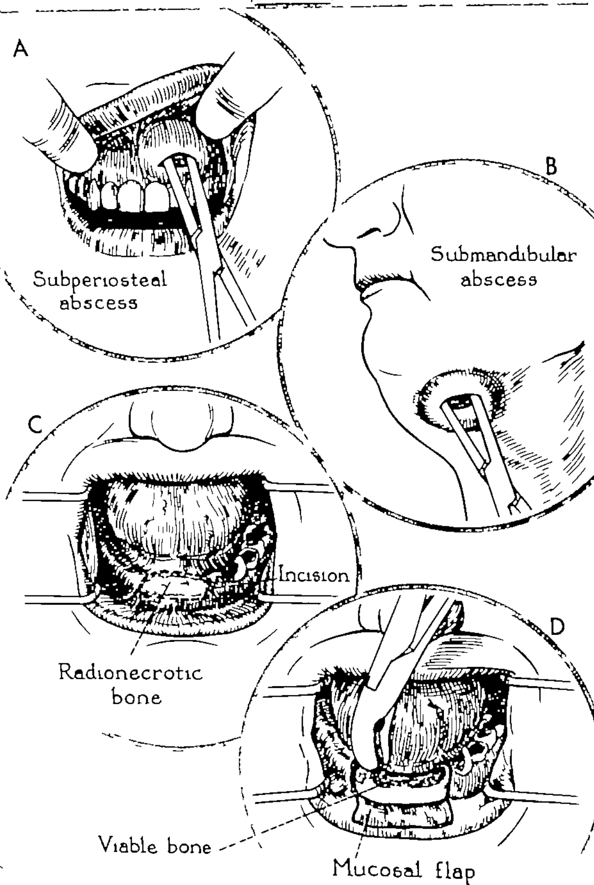
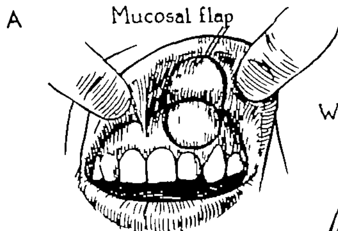
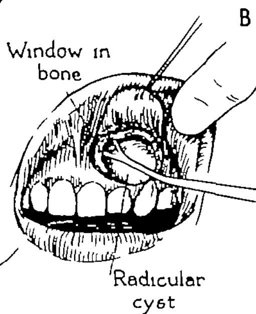
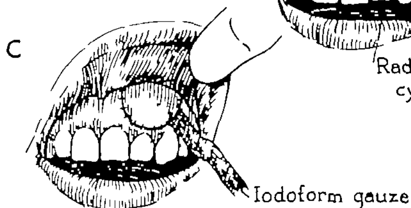
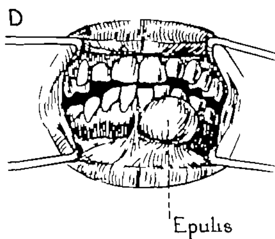

A
Subperiosteal abscess
B
Submandibular abscess
C
Incision
Radionecrotic bone
D
Viable bone
Mucosal flap

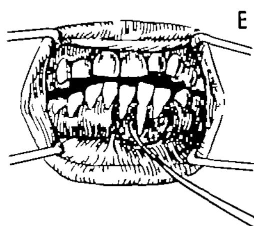
PLATE 45


A
Mucosal flap


B
Window in bone
Radicular cyst


C
Iodoform gauze


D
Epulis


E

Excision of Dental Cyst; Excision of Epulis

Excision of Dental Cyst

A number of benign epithelial-lined cystic lesions of dental origin are encountered in the mandible and maxilla The most common of these are radicular cysts originating at the site of an apical abscess, and dentigerous cysts which form around unerupted teeth or dental anomalies In the treatment of these lesions, all the epithelial lining *of the cyst must be removed, viable teeth should* not be extracted

A —A curved incision is made over the site of the cyst and a flap of mucosa and periosteum elevated

B —Small chisels and rongeurs are used to remove a window of bone over the cyst An attempt is made to avoid perforating the cyst wall Curettes and small curved elevators are then used to enucleate the intact cyst The bony cavity is curetted and irrigated

C —A pack of iodoform gauze is placed in the cavity and the mucoperiosteal flap partly sutured in place with fine silk Small cavities which are not infected may be closed without packing If packing is used, it is removed in 48 hours and the cavity kept clean with irrigations until it has been obliterated by granulations

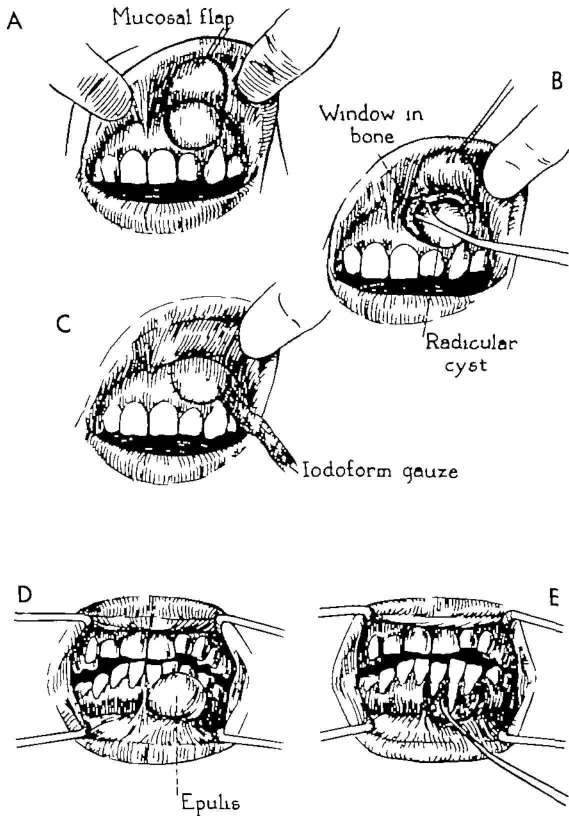
Excision of Epulis

An epulis is a spongy, bluish-red, benign tumor generally originating from the neck of a tooth with demineralization of bone in the adjacent alveolar ridge If the lesion is widely excised and the base fulgurated the tooth usually can be preserved and recurrence prevented

D —An incision is made through the mucosa of the gum around the tumor The mass is removed in one piece

E —The tumor bed is scraped clean with a curette Loose spicules of bone are removed The cavity is then fulgurated or cauterized Frequent oral irrigations are used for several days following surgery Wound healing is usually prompt

PLATE 45


A
Mucosal flap
B
Window in bone
Radicular cyst
C
Iodoform gauze
D
E
Epulis

Segmental Resection of Mandible

This operation is performed for an ameloblastoma of the mandible Diagnosis in this case was made by peroral open biopsy, and teeth in the neighborhood of the lesion have been extracted The segmental resection of the involved mandible is carried out after healing of the overlying gingiva is complete

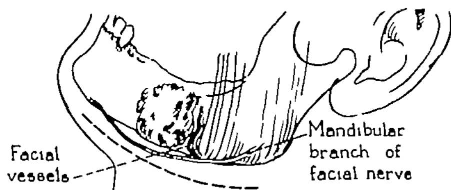
A –Endotracheal anesthesia is used An incision is made parallel with and 2 cm below the horizontal ramus of the mandible The mandibular branch of the facial nerve is identified where it crosses the facial vessels and is preserved (see Parotidectomy, Chapter 11, and Radical Neck Dissection, Chapter 14)

B –The soft parts are elevated away from the bone, exposing the tumor Posteriorly, the masseter muscle is severed near its insertion on the mandible It is occasionally possible to preserve the gingiva, using a sharp periosteal elevator If the gingiva is removed and the oral cavity entered, the opening is closed with interrupted mucosal sutures of fine silk tied within the mouth When the involved segment of bone has been isolated, it is severed with a Gigli saw 2 cm distant from the tumor It may be necessary to control bleeding from the severed bone ends with bone wax

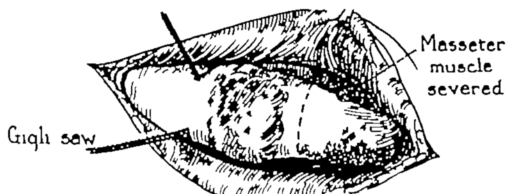
C –The gap between the bone is bridged with a splint of stainless steel (Kirschner wire, 062 in diameter) The rod is not curved to assume the shape of the resected bone, but is directed in a straight line between the bone fragments Each end of the rod is curved or angled slightly and driven into a hole drilled in the bone The soft tissues are approximated around the rod with fine chromic sutures every effort being made to avoid any dead space A drain is left in the wound for 48 hours

D –When wound healing is complete, a bone graft of rib or iliac crest may be used to bridge the mandibular defect The graft is fixed to the bone ends with small stainless steel plates or with wires placed through holes drilled in the bone The steel rod may occasionally be left in place for immobilization of the graft and mandibular fragments It is removed when bony union is complete by making an incision over it through the floor of the mouth dividing it with wire cutter and extracting each end

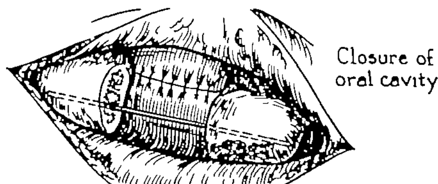
A


Facial
vessels
Mandibular
branch of
facial nerve

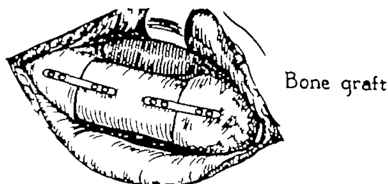
B


Masseter
muscle
severed
Gigli saw

C


Closure of
oral cavity

D


Bone graft

Mandibulectomy

Resection of the hemi-mandible is most often performed because of bone invasion by an intra-oral tumor In such circumstances, the operation includes a wide incision of the primary lesion and a radical neck dissection as illustrated in Chapter 14 The technical details of mandibulectomy alone are described here

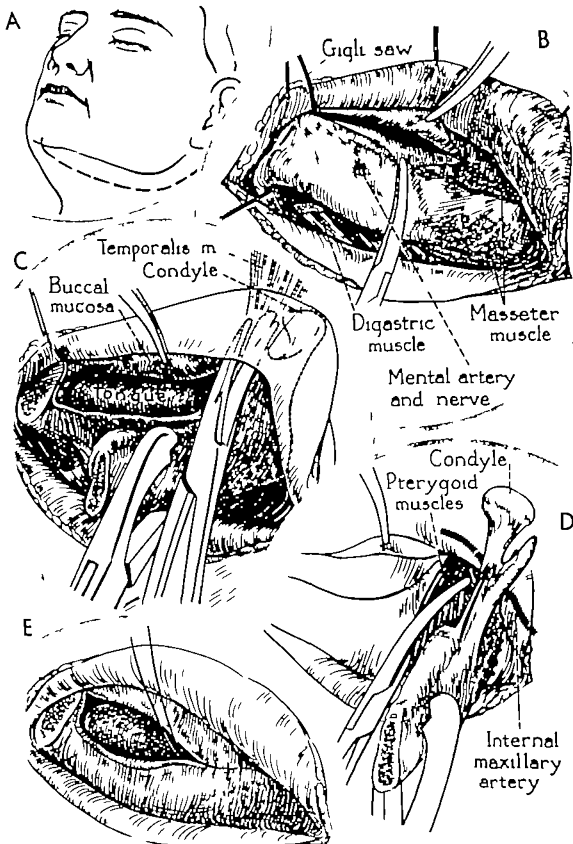
A —Endotracheal anesthesia is administered and a pharyngeal pack inserted An incision is made from the mid-point of the chin to the angle of the mandible, being carried parallel to and 2 cm below the lower border of the bone The mandibular branch of the facial nerve is identified and preserved

B —The major portion of the body of the mandible may be exposed by blunt dissection Anteriorly, a few muscular attachments and the mental nerve and artery must be divided with the scalpel Posteriorly, the masseter muscle is severed at its insertion along the angle and ascending ramus The upper outer surface of the body of the mandible is freed by incising the mucosa in the gingivobuccal sulcus The mucosa of the floor of the mouth is incised close to the gingiva

C —The mandible is divided anteriorly with a Gigli saw The bone is then grasped with a bone-holding forceps and retracted downward and rotated outward to facilitate disarticulation The temporalis muscle is located by palpation at its insertion on the coronoid process and is severed with strong curved scissors The condyle is then freed by incision of its attachments at the temporomandibular joint It is often simpler to divide the neck of the mandible just below the condyle with large rib-cutting forceps

D —The mandible is then rotated outward and its remaining attachments, the pterygoid muscles, are divided It is best to clamp these muscles proximal to their point of division to avoid troublesome bleeding from the pterygoid plexus

E —Following removal of the mandible, the oral cavity is closed with mucosal sutures of 4-0 silk with the knots tied in the mouth The underlying dead space is obliterated by numerous sutures of 3-0 chromic catgut The skin and platysma are approximated around a drain which is left in place for 48 hours


A
B
Gigli saw
C
Temporalis m
Condyle
Buccal mucosa
Tongue
Digastric muscle
Masseter muscle
Mental artery and nerve
Condyle
Pterygoid muscles
D
E
Internal maxillary artery

Stabilization of Mandibular Fragments

There are a number of methods available for stabilization of the jaw after resection of a portion of the mandible The choice of method depends on the extent and the location of resected bone, the extent of the soft part excision, and on the presence or absence of remaining upper and lower teeth A prosthodontist who is familiar with the problems involved is an invaluable aid to the surgeon It is often useful to take impressions of the maxillary and mandibular ridges and any remaining teeth before operation Casts of the normal bite are then constructed and, from these, prosthetic appliances for use after surgery may be designed

Following segmental resection of the mandible, the bone fragments may be most easily stabilized by interdental wiring if enough teeth are present Arch bars with a plastic block to fit in the mouth across the bony defect may also be used These appliances are maintained for 6-8 weeks, after which there is usually enough scarring around the bone ends to prevent shifting Internal fixation, bridging the bone defect with a steel rod (Plate 46), is also effective Secondary reconstruction of the continuity of the mandible with a bone graft may be performed later

After disarticulation and resection of the hemi-mandible, stabilization of the remaining portion is a more difficult problem Interdental wiring may be used if enough teeth remain, this method has the disadvantage of keeping the jaws closed for an extended period, interfering with intra-oral wound care, and requiring liquid feedings The construction of a vertical guide arm on the lower jaw which impinges against a horizontal bar on the buccal surface of the upper jaw is useful, since these appliances permit vertical motion but prevent lateral deviation A few upper and lower teeth must be present for these fixtures to be maintained effectively When the patient is edentulous, the mandible can occasionally be stabilized with internal metallic appliances attached to the mastoid process or the temporozygomatic area An extensive soft tissue resection frequently precludes the use of such devices Fixation by external appliances, using pins or wires attached to the remaining bone may then be attempted Frequently in such cases, however, the deviation of the jaw is accepted as a necessary consequence of the extensive surgery

CHAPTER 11

The Salivary Glands

ANATOMY

THE SALIVARY GLANDS consist of three paired sublingual, submaxillary and parotid glands and minor or ectopic groups of salivary tissue occurring in scattered locations in the oropharynx. These minor salivary glands are small collections of salivary tissue found in the mucosa of the cheek, tongue, palate floor of mouth, pharynx, lip and paranasal sinuses A salivary gland tumor may occur in any of these locations

The sublingual gland lies beneath the mucosa of the floor of the mouth at the side of the tongue and is medial and anterior to the submaxillary gland It is the smallest of the salivary glands and its many small ducts open into the midline of the mouth

The submaxillary gland lies in the triangle bounded by the anterior and posterior bellies of the digastric muscle and the ramus of the mandible It lies on the mylohyoid and hyoglossus muscles Its deep surface is in relation to the hypoglossal nerve the two accompanying lingual veins, and the lingual nerve The submaxillary duct (Wharton's duct) enters the mouth at the side of the frenulum of the tongue The external maxillary artery lies on the posterior border of the gland

The parotid gland is the most important surgically For clinical purposes the gland is described as having two portions a superficial and a deep the division between the portions being the plane of the facial nerve Anatomically division of the gland into two parts is often difficult to demonstrate since the superficial and deep portions may be fused around the facial nerve

Anatomy of the Salivary Glands

A —The facial nerve is shown after partial removal of the superficial portion of the parotid gland The nerve leaves the stylomastoid foramen in the inferior surface of the temporal bone between the styloid and mastoid processes and enters the parotid gland The plane in which the facial nerve lies marks the division between the superficial and deep portions At a point 2 to 2 5 cm from the stylomastoid foramen, the main trunk of the nerve separates into two major divisions, the temporozygomatic, supplying the orbicularis oculi, temporalis, and other muscles of expression of the upper face and the forehead, and the cervicomandibular, supplying the muscles of the upper and lower lips and the lower portion of the face and platysma The posterior facial vein and its tributaries lie within the substance of the parotid gland This vein is formed by the junction of the internal maxillary and the superficial temporal veins It lies just beneath the facial nerve and its branches The facial vein divides into posterior and anterior tributaries, the posterior division becoming the external jugular vein after joining the posterior auricular vein, and the anterior division becoming the common facial vein after its junction with the anterior facial and the superior thyroid veins The superficial temporal artery and vein lie beneath the main trunk of the facial nerve The internal maxillary artery lies on the undersurface of the deep portion of the parotid gland This portion is situated largely behind the angle and ascending ramus of the mandible in the retromandibular space Its deep surface is in close relation to the pharyngeal wall and posterior tonsillar pillar

B —Lateral view of the parotid gland, showing the large superficial and smaller deep portions The division between these portions is exaggerated to illustrate the plane of the facial nerve

C —The parotid duct (Stenson's duct) is illustrated from a drawing of a normal sialogram

D —The parotid duct enters the oral cavity opposite the second upper molar tooth

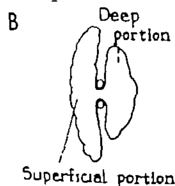
PLATE 48

A

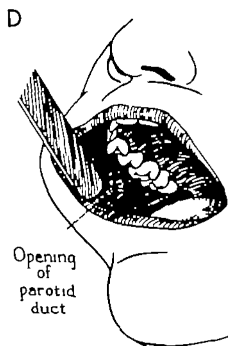
Temporozygomatic division

Main trunk of facial nerve

Cervicomandibular division







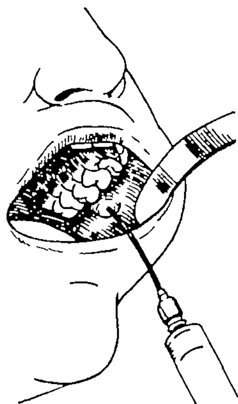
A—The facial nerve is shown after partial removal of the superficial portion of the parotid gland The nerve leaves the stylomastoid foramen in the inferior surface of the temporal bone between the styloid and mastoid processes and enters the parotid gland The plane in which the facial nerve lies marks the division between the superficial and deep portions At a point 2 to 2 5 cm from the stylomastoid foramen, the main trunk of the nerve separates into two major divisions, the temporozygomatic, supplying the orbicularis oculi, temporalis, and other muscles of expression of the upper face and the forehead, and the cervicomandibular, supplying the muscles of the upper and lower lips and the lower portion of the face and platysma The posterior facial vein and its tributaries lie within the substance of the parotid gland This vein is formed by the junction of the internal maxillary and the superficial temporal veins It lies just beneath the facial nerve and its branches The facial vein divides into posterior and anterior tributaries, the posterior division becoming the external jugular vein after joining the posterior auricular vein, and the anterior division becoming the common facial vein after its junction with the anterior facial and the superior thyroid veins The superficial temporal artery and vein lie beneath the main trunk of the facial nerve The internal maxillary artery lies on the undersurface of the deep portion of the parotid gland This portion is situated largely behind the angle and ascending ramus of the mandible in the retromandibular space Its deep surface is in close relation to the pharyngeal wall and posterior tonsillar pillar

B—Lateral view of the parotid gland, showing the large superficial and smaller deep portions The division between these portions is exaggerated to illustrate the plane of the facial nerve

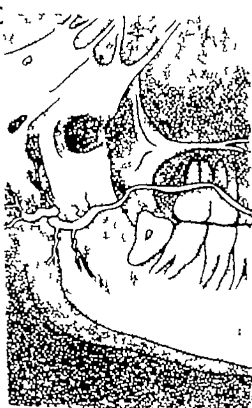
C—The parotid duct (Stenson's duct) is illustrated from a drawing of a normal sialogram

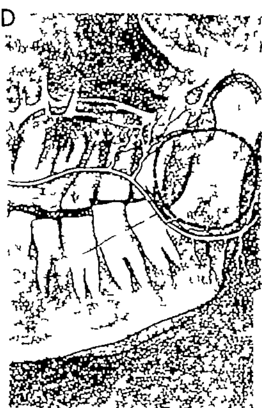
D—The parotid duct enters the oral cavity opposite the second upper molar tooth

PLATE 49









Technic of Sialography

Sialograms, obtained by injecting a radiopaque solution into the parotid duct, are often an aid in the diagnosis of parotid gland pathology Chronic parotitis may show dilated ducts or calculi Tumors lying within the gland may cause duct displacement which is not present in lesions overlying the gland Sialography can thus be an aid in differentiating true parotid lesions from those existing in the region of but outside the gland

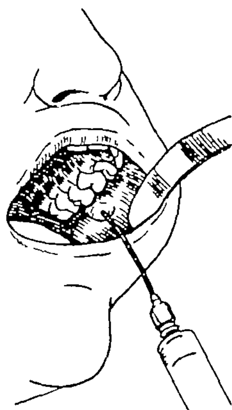
A —The orifice of Wharton's duct is first dilated, using the smallest lacrimal duct dilator At times, the meatus is so narrow that the stylet of a 20-gauge needle is required to begin the dilation A small urethral catheter is now inserted into the duct and attached, through a needle, to a syringe containing Pantopaque or Diodrast solution One and one half to two cubic centimeters of this solution are injected into the duct and oblique and lateral roentgenograms taken The catheter is held in the duct while the films are being taken to prevent loss of the solution, which flows from the duct after removal of the catheter and syringe

B —A drawing of a normal sialogram which shows the usual position and diameter of the duct Note the two main divisions of the duct

C —This sialogram shows dilation of the parotid duct in a patient who presented a chronic hard swelling in the gland This film aided in making the diagnosis of chronic parotitis rather than tumor

D —A sialogram showing displacement of the duct downward by a mixed tumor of the parotid gland

PLATE 49









] ***Removal of Salivary Duct Calculi***

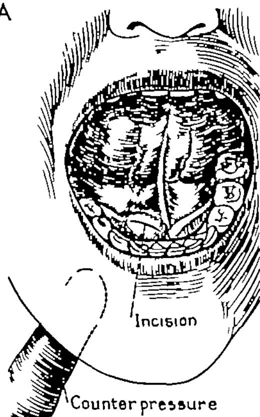
Calculi develop in the large excretory ducts of the submaxillary, sublingual, and parotid glands as well as in the smaller radicals of these ducts, where they are embedded in salivary tissue They vary in size from several centimeters to a minute granule The submaxillary duct is the most frequent site of salivary calculi, their occurrence in this location being 10 times greater than in the parotid duct Chemically, the calculi are composed chiefly of calcium carbonate and phosphate and are thus readily shown on x-ray film These obstructing stones cause intermittent swelling and pain in the affected gland When of moderate size, they can be palpated easily, either on the floor of the mouth or through the buccal mucosa in the region of the parotid duct All salivary calculi should be removed, because duct obstruction results in inflammatory changes in the blocked gland, leading to abscess, chronic fibrosis, or fistula

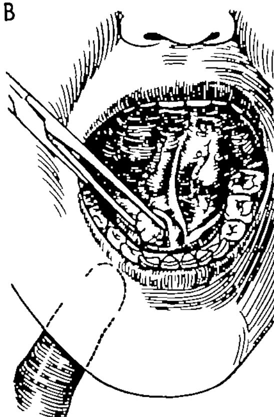
A —Removal of submaxillary duct calculus After local procaine injection, the incision is placed over the calculus and extends through the mucous membrane of the floor of the mouth and the duct wall Counterpressure against the stone by upward pressure against the submaxillary gland steadies the stone and aids in making the incision

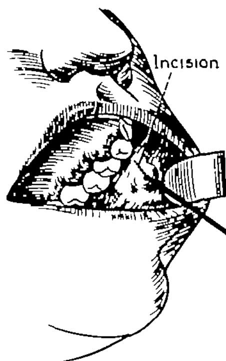
B —The calculus is grasped and, with continued pressure against it from without, is removed readily The incision in the floor of the mouth should be left open without suture

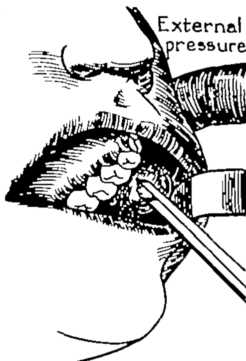
C —Removal of parotid duct calculus The calculus illustrated lies in the duct some distance from its opening A probe is inserted into the parotid duct until it touches the stone An incision is then made over the stone and onto the probe for a short distance

D —The stone can now be removed, aided by external pressure


A
Incision
Counter pressure


B


C
Incision


D
External pressure

Removal of Salivary Duct Calculi

Calculi develop in the large excretory ducts of the submaxillary, sublingual, and parotid glands as well as in the smaller radicals of these ducts, where they are embedded in salivary tissue They vary in size from several centimeters to a minute granule The submaxillary duct is the most frequent site of salivary calculi, their occurrence in this location being 10 times greater than in the parotid duct Chemically, the calculi are composed chiefly of calcium carbonate and phosphate and are thus readily shown on x-ray film These obstructing stones cause intermittent swelling and pain in the affected gland When of moderate size, they can be palpated easily, either on the floor of the mouth or through the buccal mucosa in the region of the parotid duct All salivary calculi should be removed, because duct obstruction results in inflammatory changes in the blocked gland, leading to abscess, chronic fibrosis, or fistula

A —Removal of submaxillary duct calculus After local procaine injection, the incision is placed over the calculus and extends through the mucous membrane of the floor of the mouth and the duct wall Counterpressure against the stone by upward pressure against the submaxillary gland steadies the stone and aids in making the incision

B —The calculus is grasped and, with continued pressure against it from without, is removed readily The incision in the floor of the mouth should be left open without suture

C —Removal of parotid duct calculus The calculus illustrated lies in the duct some distance from its opening A probe is inserted into the parotid duct until it touches the stone An incision is then made over the stone and onto the probe for a short distance

D —The stone can now be removed, aided by external pressure

therapy administered early appears to be of distinct value and should be a part of the treatment whenever possible Surgical drainage is indicated when there has been no response to conservative therapy in 48 hours A vertical incision is made just in front of the tragus of the ear and extends through the thickened edematous parotid capsule The wound is packed without suture

Acute inflammation of either the parotid or submaxillary glands may occur following calculous obstruction of their ducts The process usually subsides following removal of the calculi but when suppuration develops incision and drainage are required

Chronic parotitis—This chronic parotid inflammation, also known as chronic sialectatic parotitis is characterized by the intermittent swelling of one or both glands The condition is of particular importance surgically because occasionally it is difficult to differentiate from tumor The etiology of the disease is unknown At times obstruction of the parotid duct by calculus or stenosis of the ampulla is present but frequently no obstruction can be demonstrated. Pathologically there is dilatation of the intralobular ducts and a marked lymphoid infiltration of the lobules

Clinically a hard, tender swelling, 4-8 cm. in diameter develops in the gland and after persisting for several weeks gradually recedes spontaneously only to recur at intervals of several months or years At times the enlargement persists, becomes painful and incapacitating Sialograms often demonstrate diffuse or segmental dilatation of the parotid ducts and are an aid in diagnosis

If obvious obstruction of the duct is present, it should be removed. Stenosis of the ampulla should be corrected by dilatation or meatotomy Antibiotics may be given in combination or separately over a period of several weeks When the swelling persists or when differentiation from tumor cannot be made subtotal parotidectomy with preservation of the facial nerve is indicated

A similar chronic sialitis occurs in the submaxillary gland. In this gland, obstruction of the duct by a calculus is more frequently responsible for the pathology than in the parotid. However marked submaxillary sialadenitis also occurs without evidence of obstruction to Wharton's duct. The course is similar to that described for chronic parotitis Should the swelling persist, excision of the submaxillary gland is indicated

INFLAMMATION OF THE SALIVARY GLANDS

Acute surgical parotitis—Acute postoperative parotitis, considered a vanishing disease after the development of the antibiotics, is again becoming a problem The reappearance of this surgical complication is due to the emergence of resistant strains of coagulase-positive staphylococcus aureus in hospital wards and operating rooms The staphylococcus was the bacteria formerly most often found in surgical parotitis and it is the infective agent in a high percentage of the patients developing the disease today Acute parotitis occurs most frequently in patients with a debilitating disease, but may follow any surgical procedure Poor oral hygiene, a dry mouth and pharynx, and carious teeth are often present The usual route of infection ascends from the mouth through Stenson's duct into the smaller parotid ducts and lobules The pathology may be a localized or diffuse cellulitis, localized lobular abscess, or generalized suppuration Both glands may be involved, the infection beginning in one and involving the second after 2 or 3 days Occasionally, the process extends to the submaxillary glands

Typically, one parotid gland becomes swollen and painful on the 4th to 8th postoperative day The pulse and temperature are elevated and the patient becomes severely toxic The gland continues to enlarge and the overlying skin becomes red and edematous Palpation reveals marked tenderness over the parotid, and the ampulla of Stenson's duct may be large, edematous, and may drain purulent material As the process continues, areas of localized suppuration may develop and coalesce to involve the entire gland

Treatment consists of antibiotic therapy, irradiation, and incision and drainage of the parotid gland early in the course of the disease It is important to culture the purulent material obtained from the ampulla of the parotid duct after gentle massage of the gland, or from an incised abscess and to obtain bacterial sensitivity tests as early as possible The appropriate antibiotics should then be given in large doses When pus is not present and sensitivity tests are unobtainable, chloromycetin or erythromycin should be used because the causative bacteria is most likely to be a staphylococcus resistant to penicillin streptomycin, or tetracycline X-ray

therapy administered early appears to be of distinct value and should be a part of the treatment whenever possible Surgical drainage is indicated when there has been no response to conservative therapy in 48 hours A vertical incision is made just in front of the tragus of the ear and extends through the thickened edematous parotid capsule The wound is packed without suture

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NEOPLASMS—MIXED TUMORS

The so-called mixed tumor is the most common benign neoplasm of the salivary glands Its name is derived from its characteristic histology which shows it, apparently, to be composed of epithelial, myxomatous, and cartilaginous elements Recent studies, however, have demonstrated that mixed tumors are primarily epithelial in nature and that the other elements are the result of degeneration or metaplasia of the epithelial cells The tumors occur most frequently in the parotid gland, but are occasionally encountered in the submaxillary gland and rarely in the sublingual gland They may arise in ectopic salivary tissue within the oral or nasal cavities, in which locations they may be overlooked easily or incorrectly diagnosed The tumors occur equally in the male and female and are most often found in patients in their 3d or 4th decade They vary in size from a few millimeters to an extremely large mass

Mixed tumor of the parotid gland—Mixed tumors of the parotid gland are typically located in the lower third of the superficial portion in front of the lobule of the ear, or in the neck overlying the mastoid process Occasionally, they are found in the upper part of the gland, in front of the tragus of the ear, but are seldom situated at the periphery of the gland The tumors are round or oval, firm or rubbery in consistency, and are nontender They seem often to lie just beneath the skin and to be freely movable while actually they are fixed within parotid tissue

Mixed tumors of the deep portion of the parotid gland are of special interest When they exist at the border of the ramus of the mandible, they push the superficial portion outward, are palpable in the neck and cannot be distinguished clinically from tumors of the superficial portion At times, however, they bulge into the pharynx, where they cannot be palpated in the neck and can be observed only in the posterior pharynx These deep-portion parotid tumors which protrude into the pharynx may be incorrectly considered pharyngeal or tonsilar neoplasms or may be mistaken for tumors arising in ectopic salivary glands

The diagnosis of a mixed tumor of the parotid gland is often not difficult A slow-growing nontender, rounded mass situated in

front of the ear and within the parotid gland usually is a mixed tumor It must be emphasized, however that all lumps in the parotid region are not mixed tumors The inflammatory lesions chronic parotitis parotid duct calculus parotid abscess or chronic lymphadenitis of the lymph nodes within the parotid gland frequently mimic tumor Other benign parotid tumors such as cyst adenoma lymphomatosum, hemangioma, or neurmoma may be mistaken for mixed tumor Malignant tumors including early carcinoma of the parotid gland, epidermoid carcinoma, or malig nant melanoma metastatic to the parotid nodes, and lymphosar coma occur and must be considered Actually the most frequent mistake is to consider a lesion which in fact is a mixed tumor to be a simple subcutaneous fibroma or sebaceous cyst. The surgeon should not make a small incision under local anesthesia for any lesion in the parotid region unless he is prepared to perform parot idectomy should the lesion prove to be a parotid tumor Biopsy of parotid neoplasms is inadvisable because tumor is thus spread.

Treatment —All mixed tumors of the parotid gland should be removed with a wide area of surrounding parotid tissue This recommendation is the result of anatomic, follow up and pathologic studies which point incontrovertibly to its truth. It is unfor tunate that in the past the most popular method of removing a mixed tumor was to enucleate or "shell" it out from surrounding tissue This procedure led to a recurrence rate as high as 48% in some series Recurrence was so frequent that it was considered typical of the clinical course of the tumor The principal reason for the popularity of simple enucleation is based on the fear of many surgeons that wide removal leads to injury of the facial nerve Actually the reverse is true In studies of a series of patients from whom tumor was removed by enucleation there was a 14% incidence of injury to the facial nerve In a similar series of pa tients in whom subtotal parotidectomy was performed, there was no facial nerve injury This apparent paradox is explained when it is realized that the facial nerve is carefully exposed during subtotal parotidectomy Follow up studies also indicate that wide removal should be performed In our series there has been 46% recurrence in patients whose tumor was enucleated, while no recurrence has developed in patients following wide removal.

 Pathologic Reasons for Wide Removal of Mixed Tumors

Pathologic reasons for removing mixed tumors with a wide margin of salivary tissue are based on the fact that many such tumors are not enveloped by a well-defined capsule walling them off from surrounding tissue On the contrary, the capsule may be entirely absent, extremely thin, or incomplete In addition, tumor may be present within the capsule or may exist outside it

A—Benign mixed tumor extending into the capsule Such a situation requires removal of the tumor with a wide margin of normal tissue around it A portion of the capsule may easily be left by enucleation, and in this instance that portion might contain tumor cells

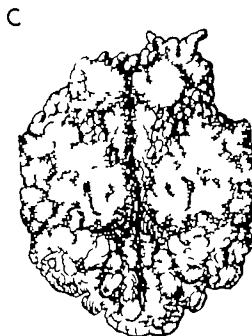
B—Mixed tumor occurring near a larger tumor but completely outside its capsule Willis demonstrated that tumor formation is frequently seen still in progress in salivary tissue near a well-established mixed tumor The presence of these satellite tumors leads to the conclusion that wide removal is indicated

C—Mixed tumor without a capsule Many recurrent, and some primary benign, mixed tumors have no capsule or are incompletely encapsulated Wide removal alone will encompass such tumors

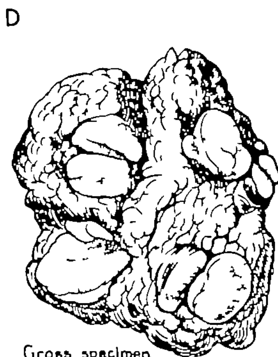
D—Multiple mixed tumors There are usually the result of "seeding" following local enucleation when the tumor is spread by breaking the capsule Only wide removal can eradicate recurrent tumors of this type successfully







Gross specimen
Unencapsulated tumor



Gross specimen
Multiple recurrent mixed tumors

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CARCINOMA

Carcinoma of the parotid carries a poor prognosis This is due to late diagnosis resulting from observation of parotid lumps believed to be benign, to the incidence of local and distant metastases and to the technical difficulty of radical removal within the tight confines of the parotid area Parotid cancers exist in many forms with different degrees of malignancy Squamous cell carcinomas many adenocarcinomas and some muco-epidermoid carcinomas are highly invasive while malignant mixed tumor and low grade muco-epidermoid cancers are generally slower growing

Clinically patients with parotid carcinoma present a wide variety of signs and symptoms When first seen, they may show the typical findings of a hard fixed rapidly growing, painful parotid mass associated with partial or complete facial paralysis However one may encounter parotid cancer with signs identical with those of benign mixed tumor and it is only after histologic examination that the diagnosis is evident

Other patients present the all too familiar finding of recurrent cancer following treatment Here a diffuse often ulcerating mass fills the parotid area and extends into the middle ear base of skull, mastoid process and mandible Finally a few patients present the history of a mass of 5-25 years duration with recent rapid growth

The treatment for parotid cancer is usually radical total parotidectomy with division of the facial nerve Sacrifice of the facial nerve is necessary for the complete removal of the gland in continuity and is always indicated when the cancer is in both superficial and deep portions, when it invades the 7th nerve or when proved recurrent cancer is present However the nerve should not be sacrificed when there is insufficient evidence that the tumor under treatment is actually cancer When dealing with an encapsulated tumor of the superficial portion completely surrounded by parotid tissue complete removal with preservation of the nerve is indicated At times it will be necessary to violate the principles of cancer and parotid surgery and cut into the tumor to obtain a biopsy and frozen section Radical neck dissection in continuity with parotidectomy is indicated if cervical metastasis is present

PAPILLARY CYSTADENOMA LYMPHOMATOSUM

These interesting tumors, also named "Warthin's tumors," occur only in the parotid gland Grossly, they appear as a round or oval cystic, encapsulated mass, 2-5 cm in diameter, situated in the lower one third of the parotid gland On cutting the tumor, many cystic spaces of variable size filled with cloudy fluid are encountered Histologically, the tumor is composed of masses of lymphocytes surrounding epithelial-lined spaces

Clinically, these tumors have an appearance similar to mixed tumors, but are usually more cystic on palpation Characteristically, they occur in older patients, usually males in the 5th or 6th decade—a distinction from mixed tumors, which usually are found in the younger age group They may be bilateral

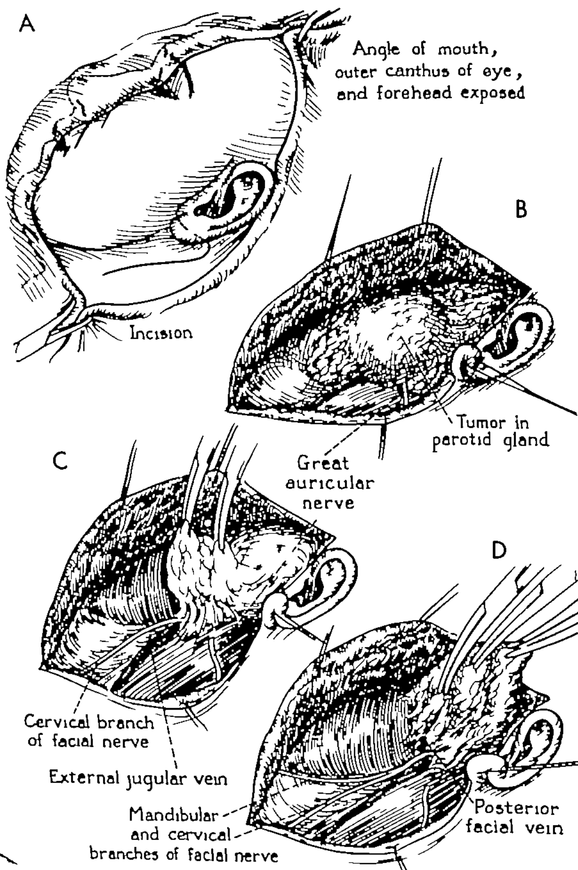
The treatment of cystadenoma lymphomatosum is similar to that of mixed tumors with the exception that it is not necessary to remove such a wide area of surrounding normal parotid tissue While recurrence is not frequent after enucleation, it has occurred It is imperative that the facial nerve be identified and protected during excision

HEMANGIOMA

Vascular tumors of the parotid gland typically appear at birth or in early infancy Pathologically, they exist as capillary hemangioma, cavernous hemangioma, or hemangioendothelioma

The diagnosis should be considered when the parotid gland in a newborn infant gradually increases in size Enlargement of the gland may occur when the infant cries The tumor is typically elastic in its consistency and is compressible At times, visible angiomas with purple discoloration of the skin are visible in the parotid region

While these tumors are benign, they frequently increase rapidly in size, invading adjacent cervical structures The treatment is surgical The entire tumor should be removed, together with the uninvolved portion of the parotid gland It is particularly important that the tumor be removed as completely as possible, because any remaining portion may undergo active growth, with recurrence The facial nerve should and can be preserved


A
Angle of mouth, outer canthus of eye, and forehead exposed
Incision
B
Tumor in parotid gland
C
Great auricular nerve
D
Cervical branch of facial nerve
External jugular vein
Mandibular and cervical branches of facial nerve
Posterior facial vein

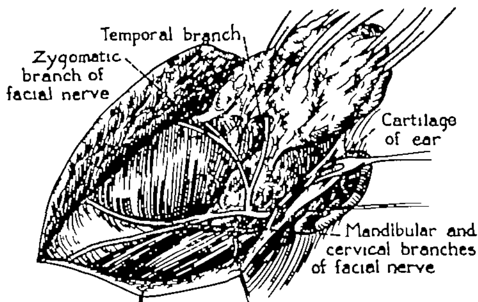
A—The entire side of the face, including the angle of the mouth, the outer canthus of the eye, and the forehead must be exposed By this draping, it is possible to observe contractions of the facial muscles when branches of the facial nerve are approached or stimulated The incision begins at the posterior angle of the zygoma and extends downward just in front of the tragus of the ear It continues behind the lobule of the ear backward over the mastoid process Following a gentle curve, it continues downward and forward on the neck, parallel to and below the body of the mandible By placing the downward limb of the incision extremely close to the cartilage of the ear instead of on the cheek, a minimal scar results This incision is recommended for all parotid tumors, regardless of their location in the gland

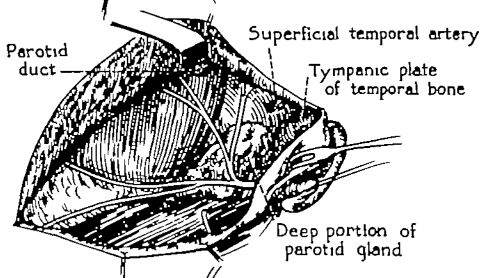
B—The skin flaps are now elevated, exposing the entire superficial surface of the gland The incision on the cheek includes the full thickness of skin down to the thin parotid fascia, that on the neck extends through the platysma Strong upward traction on the skin and firm downward pressure against the gland aids in separating these tissues by sharp dissection

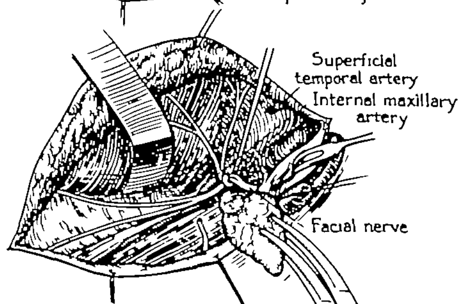
C—The upper third of the sternocleidomastoid muscle is exposed and the great auricular nerve crossing it and entering the parotid gland is identified and divided The lower pole of the parotid gland is elevated The external jugular vein is identified and traced upward into the substance of the superficial portion *The cervical branch of the facial nerve is found lying on the* anterior division of the posterior facial vein After the cervical branch is identified, it is traced back to the cervical-mandibular division and then to the main trunk of the facial nerve An alternate method is to expose the main trunk of the facial nerve as it leaves the stylomastoid foramen and to trace it outward (Plate 53)

D—Further exposure of the cervical-mandibular division of the facial nerve It is traced backward to the main trunk where the important temporozygomatic division is identified

[Parotidectomy *continued on page 198*]


E
Temporal branch
Zygomatic branch of facial nerve
Cartilage of ear
Mandibular and cervical branches of facial nerve


F
Parotid duct
Superficial temporal artery
Tympanic plate of temporal bone
Deep portion of parotid gland


G
Superficial temporal artery
Internal maxillary artery
Facial nerve

E—The parotid tissue is dissected from the cartilage of the ear and the tympanic plate of the temporal bone, keeping the temporozygomatic division of the facial nerve in view at all times This division is traced upward and its peripheral branches are protected and preserved as the parotid tissue is divided

F—The superficial portion of the parotid gland containing the tumor is now removed It is desirable to leave a cuff of parotid tissue at the periphery if, by so doing, the tumor may be removed with an area of normal surrounding tissue Occasionally, it is necessary to remove the entire superficial portion, including its periphery, in which instance the parotid duct is encountered and is ligated and divided The wound is closed, using fine cotton or catgut sutures for the platysma in the neck and superficial fascia on the face and interrupted silk for the skin A small Penrose tube drain is inserted and a large pressure dressing applied

G—When the tumor involves the deep portion alone or both superficial and deep portions, removal of the entire gland is necessary The deep portion can be removed without injury to the facial nerve by retracting the nerve upward and outward and dissecting the parotid tissue from beneath it Adequate exposure is obtained by retracting the angle and ramus of the mandible The external carotid artery and its terminal branches, the internal maxillary and superficial temporal arteries, are encountered The superficial temporal artery is ligated and occasionally it is necessary to ligate the internal maxillary artery The internal jugular vein and internal carotid artery are close to the deep portion of the gland but are usually not exposed Removal of this portion is facilitated by the assistant placing his finger in the posterior pharynx and pushing it outward After it is removed, the intact facial nerve is dropped back into its usual position and the wound closed as described above

PLATE 53

A

Parotid gland

Digastric muscle

Sternocleido mastoid muscle

B

Cartilage of external auditory canal

Superficial portion of parotid gland

Digastric muscle

Facial nerve

 Alternate Method of Identifying Facial Nerve

In the preceding description of parotidectomy, the technic of isolation of the facial nerve by identifying its cervical-mandibular division and tracing this back to the main nerve trunk was illustrated Another entirely satisfactory technic consists of a direct approach to the main trunk of the nerve just distal to its exit from the stylomastoid foramen The surgeon should be conversant with both methods, since the location of the parotid tumor may at times make one or the other preferable

A—The skin incision for parotidectomy is made and the anterior skin flap elevated, exposing the superficial portion of the parotid gland The superficial layer of the deep cervical fascia is incised just posterior to the lower pole of the parotid and the anterior margin of the sternocleidomastoid muscle is exposed and mobilized The sternocleidomastoid is retracted posteriorly and the parotid gland pulled forward, allowing the posterior belly of the digastric muscle to be identified in its location beneath the tail of the parotid This muscle is also retracted posteriorly The superior portion of the parotid is then dissected away from the tragus of the ear, exposing the cartilage of the external auditory canal The space between the external auditory canal and the parotid is widened by blunt dissection

B—The posterior belly of the digastric muscle and the cartilage of the external auditory canal form the essential landmarks for identification of the facial nerve As the digastric is retracted posteriorly, dissection is carried upward along its anterior margin, separating deep portions of the parotid from the muscle The facial nerve bisects the angle formed by the cartilage of the external auditory canal and the posterior belly of the digastric As this angle is approached, the parotid gland is dissected forward with care until the nerve is identified Once the nerve has been exposed, dissection is carried forward immediately on its surface and the superficial portion of the parotid gland removed in the manner previously described

PLATE 54

A

Parotid gland and tumor

Hypoglossal nerve

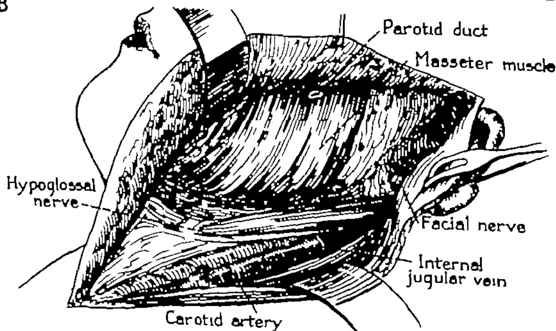
Facial nerve

Accessory nerve

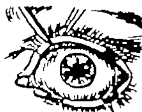
Internal jugular vein

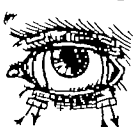
Sternocleidomastoid muscle

B



C







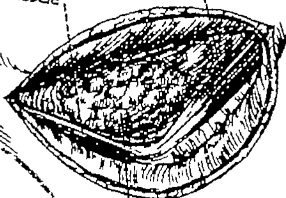
When unmistakable pathologic proof is obtained that a parotid tumor is malignant, a radical removal of the gland with sacrifice of the facial nerve is frequently indicated It is our feeling that unless the cervical nodes are proved to contain tumor, by aspiration or other form of biopsy, radical parotidectomy together with a dissection of the jugular fossa is sufficient therapy, a neck dissection being performed at a later date, when indicated

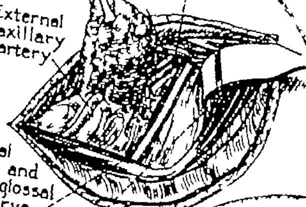
A—The incision is similar to that used for simple parotidectomy, with the cervical portion extending farther forward on the neck The posterior belly of the digastric muscle, the hypoglossal and spinal accessory nerves, the internal jugular vein, and the external carotid artery are identified The external carotid artery is ligated and divided at the angle of the mandible The dissection of the parotid gland begins at the posterior border of the submaxillary gland and continues backward and upward The gland is removed together with the lymph nodes and areolar tissue from the internal jugular vein and from the digastric and sternocleidomastoid muscles, the dissection in the jugular fossa extending to the base of the skull The parotid gland is freed from the mastoid process and the trunk of the facial nerve is identified and divided as it leaves the stylomastoid foramen The deep portion extending beneath the ramus of the mandible is removed in continuity with the remainder of the parotid tissue Should the tumor extend widely into the deep portion, it may be necessary to remove a part of or the entire ramus of the mandible

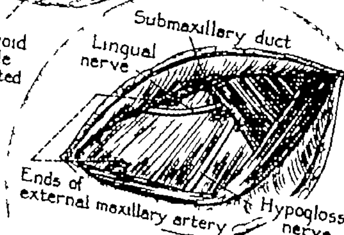
B—At the conclusion of the operation, the entire parotid bed has been cleared, with exposure of the masseter muscle, the angle of the mandible, and the jugular fossa The skin flaps are approximated and a small Penrose drain inserted in the lower angle of the wound

C—A fusion of the eyelids should be performed at the time of or soon after sacrifice of the facial nerve, to prevent corneal ulceration Opposing areas of the lid margins near the inner and outer canthi are denuded, using a fine scalpel and forceps A 2 × 4 mm rectangular segment of tissue is excised, including the lid margin and the cilium Double-armed sutures of fine silk are then used to fuse the denuded areas, the sutures are brought out through the skin of each lid and tied over rubber tubing


A
Incision


B
Anterior belly,
posterior belly
of digastric
muscle
Submaxillary
gland


C
Submaxillary
duct
Lingual nerve
External
maxillary
artery
Lingual
veins and
hypoglossal
nerve
Mylohyoid
muscle
retracted


D
Submaxillary duct
Lingual
nerve
Ends of
external maxillary artery
Hypoglossal
nerve

] *Excision of the Submaxillary Gland*

Excision of the submaxillary gland is performed for mixed tumors and for multiple calculi associated with extensive chronic inflammation The gland is also removed during radical neck dissections for metastatic cancer in continuity with surrounding tissue

A —For simple excision, the incision is made 4 cm below and parallel to the body of the mandible, extending from the angle of the mandible forward to beneath the chin It is deepened through the skin and platysma

B —The skin flaps are dissected on a plane between the undersurface of the platysma and the cervical fascia covering the gland The upper flap need not be dissected beyond the body of the mandible The mandibular branch of the facial nerve must be identified and protected The anterior and posterior bellies of the digastric muscle are clearly identified and the entire superficial surface of the gland exposed

C —Beginning at its anterior border, the submaxillary gland is elevated from the mylohyoid muscle The free edge of this muscle is retracted forward, exposing the lingual veins and the hypoglossal nerve, lying on the hyoglossus muscle By blunt dissection, the deep surface of the gland is freed and the submaxillary duct ("Wharton's duct") and the lingual nerve lying medial to it are identified The duct is ligated and divided and the gland freed backward, to its posterior border The external maxillary artery is divided at the posterior border of the gland and again at the edge of the mandible

D —The submaxillary gland can now be removed completely The divided ends of the external maxillary artery and the submaxillary duct are shown here The hypoglossal and lingual nerves have been preserved

The wound is closed by approximating the platysma with interrupted fine sutures of cotton or catgut and by closing the skin after placing a small Penrose tube drain in the submaxillary bed

roid state as evidenced by a normal basal metabolic rate, normal resting pulse, weight gain and disappearance of other signs and symptoms of thyroid toxicity Lugol's solution, 10 drops twice daily is given the last 2 weeks of treatment for its involuting effect on the gland and the antithyroid drug is discontinued 1 week before surgery At surgery the aim should be to remove [illegible] of the thyroid tissue present.

Thyroiditis—Acute thyroiditis is seldom a surgical problem unless evidence of suppuration appears Antibiotics supplemented with cortisone have proved useful in control of the acute inflammatory process The rare case of acute purulent thyroiditis is managed by incision and drainage Surgery becomes indicated in chronic thyroiditis to relieve pressure symptoms or to rule out cancer as a cause of the thyroid enlargement In Riedel's struma, the gland is densely fixed to surrounding structures and serious complications including tetany and recurrent nerve palsy may occur following attempts at total or subtotal removal It seems wiser to remove merely the isthmus of the gland to relieve constriction of the trachea In Hashimoto's disease a bilateral partial thyroidectomy may be performed to alleviate pressure symptoms Myxedema is a frequent end result of chronic thyroiditis and must be treated with thyroid extract.

Thyroid nodules—A common surgical problem is the management of the nodular thyroid There is abundant evidence that a certain number of seemingly benign lumps palpable in the gland will be found on removal to be cancer This is particularly true of the solitary nodule palpable on physical examination. In large colloid goiters, there is occasionally some question of an associated mass Treatment with desiccated thyroid and Lugol's solution will often reduce the size of the gland, allowing more accurate palpation There is a particularly high incidence of cancer in thyroid nodules discovered in children For this reason, every thyroid mass in a child demands surgical management In adults history of a thyroid mass present for many years is no guarantee that cancer is not present It is unlikely that cancer will be present in a calcified adenoma in an elderly patient and clinical observation may be justified in such a setting

Since operation is advised because a lump in the thyroid may

CHAPTER 12

The Thyroid and Parathyroid Glands

As KNOWLEDGE of the physiology of the thyroid and parathyroids has grown, surgical management of diseases of these glands has become increasingly effective Accurate diagnosis of disorders of thyroid function may be obtained by studies of the basal metabolic rate, blood cholesterol, and protein-bound iodine, and by calculation of the uptake and excretion of tracer doses of radioactive iodine Parathyroid function may be evaluated by studies of serum calcium, phosphorus, and alkaline phosphatase, and by urinary calcium and phosphate excretion Surgery on the thyroid is indicated for hyperthyroidism, some cases of thyroiditis, thyroid nodules, and for cancer Parathyroid surgery is largely limited to the excision of functioning parathyroid tumors

Hyperthyroidism —Therapeutic use of radioisotopes may in the future supplant surgery in the management of hyperthyroidism At present, however, it is our conviction that surgery is the treatment of choice for this disease Radioiodine is administered only where medical contraindications to surgery exist and in certain selected cases of recurrent hyperthyroidism We have been reluctant to use radioiodine in young patients because of its possible genetic effect as well as the possibility of carcinogenesis

Careful preparation of the hyperthyroid patient for surgery is essential for the safety and success of thyroidectomy Antithyroid drugs (propylthiouracil, 200-600 mg per day, or tapazole, 20-40 mg per day) are administered until the patient reaches a euthy-

frequent enough to warrant routine total thyroidectomy as treatment for thyroid cancer Contralateral radical neck dissection is reserved for those patients with clinical evidence of metastases to the opposite side of the neck from the primary tumor Routine postoperative radiotherapy is not felt indicated for thyroid cancer It is administered, however when gross tumor must be left in the neck at operation and for inoperable recurrences A small number of thyroid cancers particularly those with a follicular and alveolar component, show sufficient avidity for radioiodine for the use of this isotope in the treatment of recurrences and distant metastases

Hyperparathyroidism —The diagnosis of hyperparathyroidism must be considered in the presence of urinary calculi and of skeletal lesions in which demineralization of bone is prominent Hyperparathyroidism also has been found associated with gastric or duodenal ulcers and with pancreatitis Once the diagnosis is considered it may be confirmed or excluded by a number of laboratory examinations The most important laboratory finding is an elevated serum calcium in the presence of normal serum proteins Low serum phosphate, hypercalcuria, and hyperphosphaturia offer additional evidence Serum alkaline phosphatase levels are elevated in the presence of skeletal lesions In the occasional patient with equivocal laboratory findings carefully performed balance studies are of great value

The usual cause of primary hyperparathyroidism is an adenoma of one parathyroid gland Diffuse hyperplasia of the glands multiple adenomas and carcinoma are of rare occurrence A parathyroid tumor is seldom palpable in the neck. Once the diagnosis of primary hyperparathyroidism has been made the surgeon must be prepared to search for the parathyroid tumor in all its possible locations Most adenomas are discovered in the usual sites of parathyroid glands on the posterior surface of the thyroid in the neck Less commonly the tumor will be found in the superior mediastinum, between the trachea and esophagus behind the esophagus or even within the substance of the thyroid gland. It is important to remember that parathyroid adenomas may be multiple an attempt should always be made to identify all four parathyroid glands In the instances of primary parathyroid hyperplasia three glands are totally removed with a partial removal of the fourth

be cancer, simple enucleation of the lump or subtotal removal of the involved thyroid lobe would seem to violate a basic principle of cancer surgery, namely, block excision of the tumor with wide margins of normal surrounding tissue It is our opinion that the poor end results in the treatment of thyroid cancer may to some degree be ascribed to inadequate removal of the mass in the thyroid when it is first seen If the seemingly innocuous lump is removed by enucleation or a subtotal thyroidectomy, the excision is usually felt to be incomplete, and further surgery becomes necessary

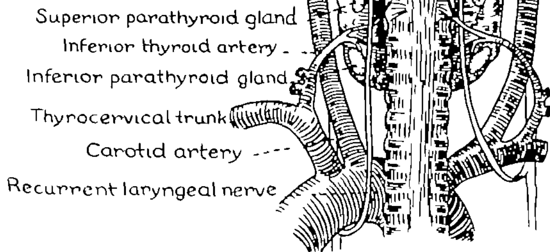
The solitary lump in the thyroid should be treated by total removal of the involved portion If the lump is found to be a cancer, local eradication of the tumor will then have a good chance of being complete If multiple nodules are present, with involvement of both portions of the gland, the surgeon must compromise Total thyroidectomy, with resultant myxedema and occasionally hypoparathyroidism, cannot be recommended It is usually best to perform a total lobectomy on the side in which the firmest and largest nodule is found A subtotal removal of the opposite portion is then performed Excised thyroid nodules should be examined immediately by the pathologist and an attempt made to reach a diagnosis before the operation is completed

Thyroid cancer—It is our belief that cancer of the thyroid should be treated by total removal of the involved portion of the gland and by an ipsilateral radical neck dissection If the pathologist can make a diagnosis of cancer on immediate examination of an excised part of the thyroid, neck dissection may be carried out without delay If a diagnosis cannot be made at once, further surgery must be postponed until paraffin sections of the tissues are studied In some instances, the first evidence of thyroid cancer may be an enlarged cervical lymph node which is biopsied and found to contain metastatic carcinoma of thyroid origin A thyroid lobectomy and radical neck dissection should then be performed on the side of the involved node Total thyroidectomy is carried out only in the case of cancer grossly involving both portions of the gland or in the uncommon situation in which recurrent cancer or a second primary tumor appears in the remaining portion following unilateral removal The above occurrences have not seemed

PLATE 56

A

Superior laryngeal nerve
Superior thyroid a. and v
Pyramidal portion
Prelaryngeal node
Middle thyroid vein
Inferior thyroid artery
Carotid artery
Pretracheal nodes
Recurrent laryngeal nerve
Inferior thyroid vein
Vagus



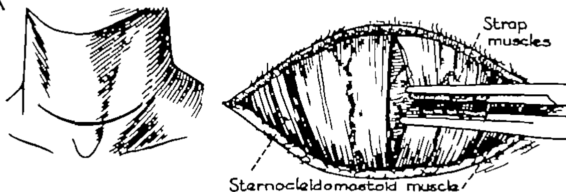
In this region, the blood supply to the thyroid, the lymphatic drainage, the position of the recurrent laryngeal nerves, and the location of the parathyroid glands are of particular importance

A —The superior thyroid artery usually arises as the first branch of the external carotid just above the carotid bifurcation In its course toward the superior pole of the thyroid, it lies close to the external branch of the superior laryngeal nerve and this nerve is subject to damage when the artery is clamped high above the gland The inferior thyroid artery usually arises from the thyrocervical trunk of the subclavian, ascends beneath the prevertebral fascia into the neck, and crosses medially behind the carotid sheath It then penetrates the prevertebral fascia to reach the posterior surface of the thyroid gland The thyroid is drained by three pairs of veins The superior vein accompanies the superior thyroid artery and empties into the internal jugular or common facial vein at the level of the carotid bifurcation The middle thyroid vein leaves the midlateral aspect of the thyroid portion, crosses the common carotid artery and joins the internal jugular The inferior vein emerges from the lower pole of the gland and descends to join the innominate vein Lymph drainage is most commonly to the middle and lower groups of jugular lymph nodes There is also drainage to pretracheal and prelaryngeal nodes from the isthmus and medial portions of the gland

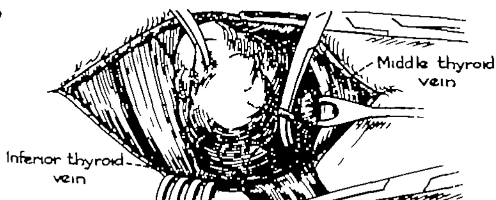
B —As the recurrent laryngeal nerves ascend from the mediastinum, they come to lie in the tracheo-esophageal sulcus or somewhat lateral to this groove The nerves have a variable relation to the inferior thyroid arteries and to the posterior surface of the thyroid Each may cross in front of or behind the artery, or may pass between its branches At the level of the upper two or three tracheal rings, each nerve is closely applied to the posterior surface of the thyroid and may at times even penetrate the gland The nerves commonly divide into anterior and posterior branches before entering the larynx Parathyroid glands may lie anywhere in the visceral compartment of the neck between the carotid bifurcation and the superior mediastinum The superior glands commonly are found well posteriorly on or near the capsule of the upper third of the thyroid The inferior glands lie less far posteriorly on the lower poles close to major branches of the inferior thyroid artery

PLATE 57

A



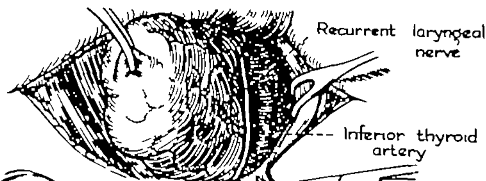
B



C



D



Thyroid Lobectomy

General endotracheal anesthesia is used. The patient is positioned with a sandbag beneath his shoulders and the neck extended.

A.—A transverse collar incision is made through the skin and platysma approximately 2 cm. above the sternoclavicular junction. Skin flaps are raised by sharp and blunt dissection to the level of the cricoid cartilage above and the sternoclavicular joints below. The fascia in the midline between the strap muscles is incised and a finger is introduced beneath the strap muscles on each side to palpate the entire thyroid gland. The anterior margin of the sternocleidomastoid muscle is exposed and the strap muscles are divided between straight clamps and retracted upward and downward, exposing the involved lobe.

B.—The sternocleidomastoid is retracted laterally and the lower pole of the lobe is gently elevated. The inferior and middle thyroid veins are divided between clamps and ligated. This allows further elevation and medial rotation of the lobe.

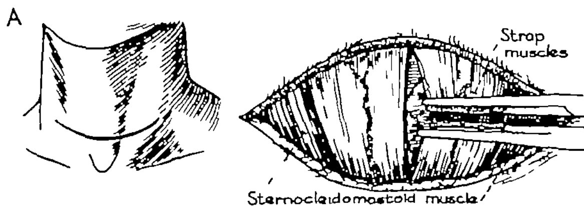
C.—As the lobe is rotated, the inferior thyroid artery may be identified coursing transversely to reach the undersurface of the gland. At this point, the recurrent laryngeal nerve must be identified. We believe that identification and isolation of the recurrent nerve is as important in surgery of the thyroid as identification of the facial nerve is in parotid surgery. The loose areolar tissue behind the thyroid is gently divided as dissection proceeds posteriorly and medially toward the tracheo-esophageal sulcus. Meticulous hemostasis is maintained, since identification of the nerve is difficult in bloodstained tissues. The nerve is generally discovered passing upward alongside the trachea at right angles to the inferior thyroid artery. On the right, the nerve tends to course more obliquely just above the clavicle, while on the left, its course is nearly vertical. Careful dissection at this point will allow identification of the recurrent nerve as it passes upward and crosses, usually, beneath the artery.

D.—Once the nerve has been identified, the inferior thyroid artery is divided and secured. The lobe is rotated farther toward the midline and dissection is carried upward along the course of the nerve toward its entrance into the larynx. The nerve is kept in view at all times. As the thyroid lobe is dissected away from the recurrent nerve, several small blood vessels are divided.

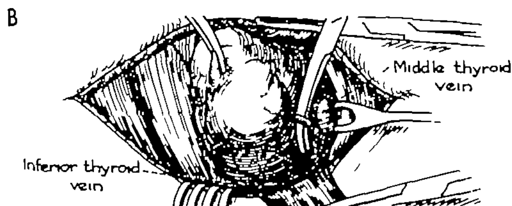
[*Thyroid lobectomy continued on page 211.*]

PLATE 57

A



B



C



D



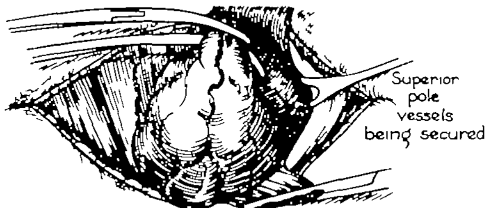
E—When the recurrent nerve has been cleared throughout its course from the level of the inferior thyroid artery to near its entrance in the larynx behind the cricothyroid articulation, the vessels of the upper pole of the thyroid may be secured Exposure is obtained by dissection in the avascular plane between the trachea and the upper pole of the gland The lobe is gently pulled downward as the vessels are secured so that clamps may be placed above all thyroid tissue in the upper pole Loss of control of the superior thyroid artery results in hemorrhage which may be difficult to manage For this reason, the superior pole vessels are generally secured with a 3-clamp technic or are ligated and transfixed in continuity before division

F—The lobe is then further elevated, freeing it from the trachea by sharp dissection It is often quite intimately attached to the trachea and cricoid cartilage by fibrous bands The isthmus is similarly elevated and is divided between clamps well beyond the midline If a pyramidal lobe is present, it is also removed An immediate pathologic examination of the resection portion should be obtained at this point, since this is the best opportunity for performing a radical neck dissection if cancer is present

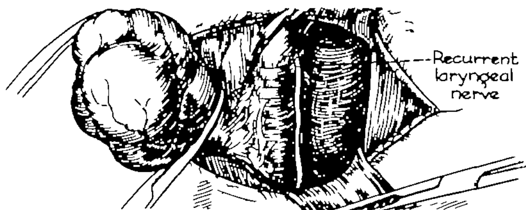
G—If the pathologist is unable to make an immediate diagnosis of cancer, the severed strap muscles are approximated with several mattress sutures The muscles are also approximated in the midline A small drain is placed in the thyroid bed and brought out between the strap muscles and sternocleidomastoid

H—The wound is closed by separate approximation of the platysma and skin edges If a diagnosis of cancer is made before the conclusion of the operation, the operative incision is extended (see Plate 72) and a radical neck dissection performed The only difference between a radical neck dissection performed for thyroid cancer and the operation described in Chapter 14 is that in thyroid cancer the prethyroid muscles on the involved side are removed in addition to the sternocleidomastoid and omohyoid

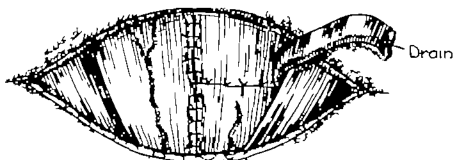
E


Superior
pole
vessels
being secured

F


Recurrent
laryngeal
nerve

G


Drain

H

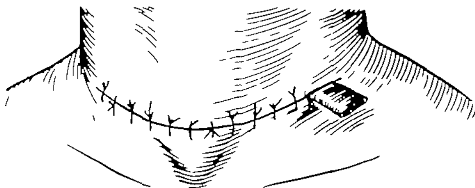
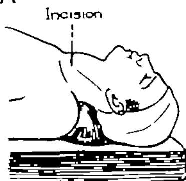
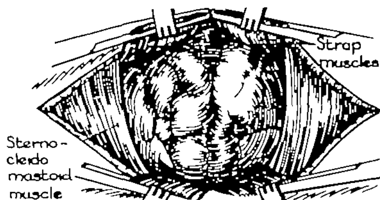


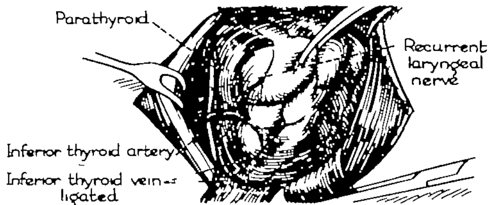
PLATE 58

A





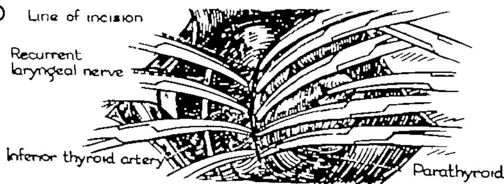
B



C



D



This operation is performed for thyrotoxicosis. Its aim is the removal of $\frac{5}{6}$-$\frac{7}{8}$ of functioning thyroid tissue The procedure may occasionally be used for a multinodular goiter A total lobectomy is performed on the side containing the most suspicious nodules, followed by a subtotal removal of the opposite lobe General endotracheal anesthesia is used and the patient positioned with the shoulders elevated and the neck extended

A –Exposure is similar to that obtained for thyroid lobectomy However, the strap muscles on each side are divided and retracted to expose both lobes of the thyroid gland

B –Starting on one side, the middle and then the inferior thyroid veins are divided between clamps and secured The lobe is elevated and rotated medially and the inferior thyroid artery exposed The course of the recurrent laryngeal nerve beneath or over the inferior thyroid artery is identified An attempt is made to identify the parathyroid glands, 1-3 mm globules of brownish tissue on the posterior surface of the thyroid lobe or in the adjacent loose areolar tissue

C –The superior pole of the lobe is isolated and the superior pole vessels divided and secured

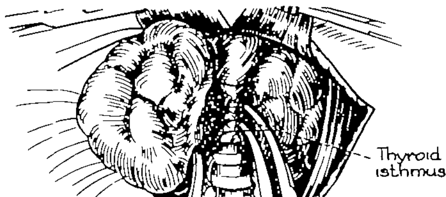
D –A line of incision on the posterior surface of the lobe is selected at a safe distance from the recurrent nerve and the parathyroids Paired clamps are placed on the thyroid capsule across branches of the inferior thyroid artery along this line and the incision started between the clamps The vessels are ligated individually as they are divided

[Subtotal thyroidectomy *continued on page 218*]

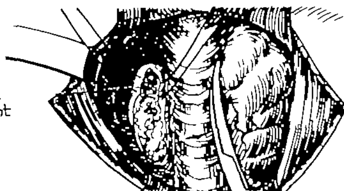
E


Recurrent
laryngeal nerve
Inferior thyroid
artery

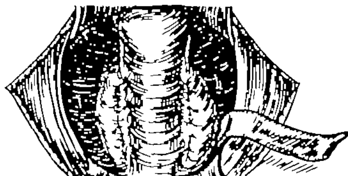
F


Thyroid
isthmus

G


Thyroid
remnant

H



E—After the incision has been carried through the capsule on the posterior surface of the lobe, clamps are placed deeper into thyroid tissue The incision is carried between the clamps toward the trachea The surgeon should aim to leave only a small rim of thyroid tissue posteriorly with its capsule Numerous small vessels are grasped with hemostats as the lobe is incised

F—The isthmus of the thyroid is elevated from the midline of the trachea by blunt dissection and is divided between clamps The lobe is elevated and removal of the greater part anteriorly is completed

G—Complete hemostasis is obtained by placing fine sutures around the clamps on the thyroid remnant and by careful suture of other small bleeding vessels Sutures are then placed to approximate the lateral cut edge to the medial edge of the thyroid capsule to further insure hemostasis

H—The same procedure is repeated on the opposite side If a pyramidal lobe is present, it is entirely removed At the conclusion of the operation, only a small posterior remnant of each lobe remains and the anterior tracheal wall is bare The wound is carefully inspected for small bleeding points Drains are inserted in each thyroid bed, the strap muscles are reapproximated and the wound closed as in thyroid lobectomy

PLATE 59

A

B

Substernal thyroid

PLATE 60

A

B

Operation for Substernal Thyroid

A—The blood supply to the intrathoracic thyroid comes from above After division and retraction of the strap muscles, the superior pole vessels are secured in the usual manner The middle thyroid vein and the inferior thyroid artery often can be identified and secured before the substernal mass is delivered With gentle upward traction on the upper pole, a finger is introduced along the side of the gland down into the mediastinum The lower lobe of the gland is freed by gentle finger dissection By a combination of traction from above and pressure from below, the mass is slowly delivered into the neck

B—The lobe usually has a dumbbell configuration due to constriction at the thoracic inlet As the wide lower pole is brought upward, pressure on the trachea may cause respiratory distress Manipulation is halted for a moment and then gently resumed As the gland is elevated, the inferior thyroid vein comes into view and is secured When the entire lobe has been delivered, it is handled in the usual manner (see Thyroid Lobectomy) The retrosternal cavity is usually obliterated by expansion of the lung

Total Thyroidectomy

A—The procedure described for thyroid lobectomy is performed on each side The entire isthmus and the pyramidal portion, if present, are also removed During the procedure, search is made for the parathyroid glands Each parathyroid identified is carefully dissected away from the thyroid and left in situ in the retrothyroid region, preserving its blood supply, if possible

B—At the conclusion of the procedure, the operative specimen is carefully inspected for parathyroid tissue Any small pink to brown nodules, 4-6 cm in size, on the posterior capsule of the gland are removed A small incision is made in the belly of the sternocleidomastoid muscle and the parathyroid tissue transplanted into this space The muscle is closed around the transplant with a single suture The wound is drained and closure is the same as following subtotal thyroidectomy

PLATE 61





C

Internal mammary artery and vein

Thyroid gland

Carotid artery

Inferior thyroid vein

Left Innominate vein

Aortic arch

Thymic remnant

Excision of Parathyroid Adenoma

A.—The incision is identical to that for subtotal thyroidectomy, the strap muscles being divided on both sides to provide wide exposure. The plan of procedure should be orderly, with meticulous hemostasis, in order to identify normal parathyroid glands as well as the adenoma. The right lobe of the thyroid has been mobilized with division of the inferior and middle thyroid veins and rotation of the gland toward the midline. After normal superior and inferior parathyroid glands have been identified, the right lobe is returned to its bed and the left lobe similarly mobilized. On the left side in this patient, a normal inferior parathyroid is identified but the superior gland cannot be seen. However, a branch of the superior thyroid artery is seen extending downward.

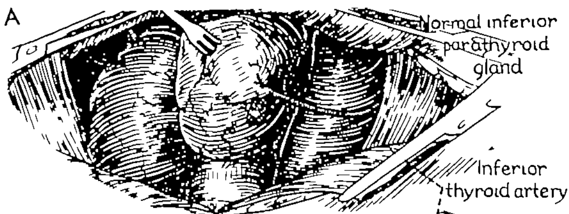
B.—An anomalous branch of the superior or the inferior thyroid artery will often provide a clue to the location of the tumor. The vessel is traced downward and a 2 × 1 cm. adenoma is discovered deep behind the head of the left clavicle. The adenoma is excised after ligation of its vascular pedicle and the wound closed as described in Plate 57. Postoperatively, the patient may show signs of mild or severe tetany requiring treatment (see Chapter 4).

Anterior Mediastinotomy

C.—A vertical incision is extended from the cervical wound downward over the midline of the sternum and curved outward to the left or right through the second intercostal space. The mediastinal pleura is bluntly dissected away from the sternum and a Lebsche sternal-splitting knife used to divide the sternum in line with the skin incision. As the incision is carried outward in the second interspace, the internal mammary vessels, coursing vertically about 1-2 cm. from the sternum, are secured.

A Finochietto retractor is used to obtain wide exposure. In searching for parathyroid adenomas, thymic remnants may have to be removed. The underlying innominate veins joining to form the superior vena cava are protected. At the conclusion of mediastinal exploration, the sternum is repaired with interrupted sutures of no. 28 steel wire passed through drill holes in the bone. If pneumothorax has occurred, a tube thoracostomy is performed.

A



B



C

Thyroid gland
Carotid artery
Inferior
thyroid vein
Left
Innominate vein
Aortic arch
Internal mammary
artery und vein
Thymic
remnant

CHAPTER 13

Cervical Infections; Lesions Primary in the Neck

Anatomy of the Fascial Layers and Spaces

Understanding of the cervical fascia contributes to the safety of surgery of the neck. Dissection along fascial planes is essential to the success of many operations performed in this region, and knowing where these planes lie adds considerably to the ease and security of the procedures. In addition, familiarity with the location and boundaries of the spaces formed by the cervical fascia leads to logical and effective approach to deep cervical abscesses. Infections of these spaces have again become frequent because of the emergence of strains of antibiotic-resistant bacteria. The anatomy of the deep fascia of the neck, when first studied, seems unnecessarily complicated and difficult, but when viewed broadly and when thought of during each excursion into the neck, soon becomes easier to understand.

Briefly, the deep cervical fascia consists of three layers: the superficial, the middle or pretracheal, and the posterior or prevertebral. The superficial layer of the deep fascia arises from the spinous processes of the cervical vertebrae, splits to surround the trapezius muscle, then crosses and forms the roof of the posterior triangle. It surrounds the omohyoid and sternocleidomastoid muscles and extends superficially to the strap muscles across to the opposite cervical region. At the sternum, it splits to form the parasternal space of Burns, which contains the sternal heads of the sternocleidomastoid muscle and a lymph node. Above, it is attached

first to the hyoid bone and then to the body of the mandible and to the occipital and temporal bones The fascia forms the capsule of the submaxillary and parotid glands being particularly dense at the anterior margin of the sternocleidomastoid muscle From this region, it extends upward, enveloping the masseter and internal pterygoid muscles and reaches the zygomatic arch.

The middle layer also known as the pretracheal fascia, derives from the anterior layer at the anterior border of the sternocleidomastoid muscle below the hyoid bone and crosses beneath the strap muscles in front of the thyroid gland and trachea It is not present above the hyoid bone Below the fascia is continued into the mediastinum as it follows the undersurface of the strap muscles behind the sternum. It is attached to the posterior surface of the manubrium at the insertion of the sternothyroid muscle The pretracheal fascia together with the strap muscles thus form the strong anterior covering of the visceral space In the region of the carotid vessels laminae extend from the fascia to form the carotid sheath which surrounds the common carotid artery the internal jugular vein, and the vagus nerve The compartment formed by this sheath may be an important route for infection to pass from the upper neck into the mediastinum.

The posterior layer begins at the cervical spines and extends deep to the trapezius muscle where it is in contact with the anterior layer At the posterior triangle it lies on the scalene muscles and sends laminae to surround the brachial plexus Beneath the sternocleidomastoid muscle this fascia lies superficial to the phrenic nerve and shields it from injury during radical dissection in this area The posterior fascial layer passes beneath the carotid vessels and the carotid sheath and is attached to the transverse processes It extends behind the esophagus and crosses to the opposite side in front of the bodies of the cervical vertebrae As it crosses in front of the vertebrae it is composed of two layers an anterior layer known as the alar fascia and a posterior layer or prevertebral fascia A compartment is formed by these layers which extends from the base of the skull down through the posterior mediastinum to the diaphragm Infection in the retropharyngeal space may spread to this deeper compartment and be transmitted into the posterior mediastinum

A—Note the three layers of the deep cervical fascia as they appear in cross section below the hyoid bone The important space shown here is that bounded by the pretracheal and prevertebral fascia, containing, at this level, the thyroid gland, trachea, and esophagus This compartment is known as the visceral space and is continuous above with the parapharyngeal and retropharyngeal spaces It must be emphasized that this single space, with different names according to its level in the neck, is continuous from the base of the skull to the bifurcation of the trachea It is one of the pathways by which infection may be carried from the neck to the mediastinum

B—The parapharyngeal space lies lateral to the pharynx and deep to the anterior layer of the deep cervical fascia It completely encircles the pharynx Its outer wall is formed by the mandible, the internal pterygoid muscle, and the deep surface of the parotid gland The space extends forward into the submaxillary and sublingual areas Infection involving the tonsils, pharynx, and teeth may invade this space rapidly

C—The submandibular space is the forward extension of the parapharyngeal and submaxillary spaces Its roof is formed by the mucous membrane of the floor of the mouth and its floor by the anterior layer of the deep cervical fascia extending from the hyoid bone to the mandible The mylohyoid muscle separates the space into two divisions In order to drain this area adequately, it is necessary to divide the mylohyoid muscle

A

Superficial layer, deep cervical fascia

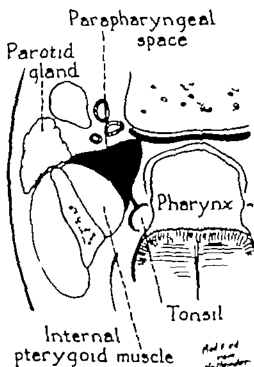
Pretracheal fascia middle layer

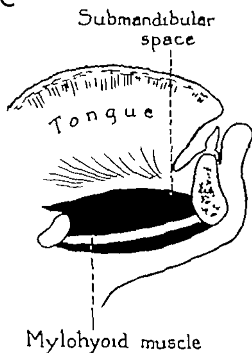
Carotid sheath

Thyroid gland

Trachea

Prevertebral fascia deep layer





Deep Cervical Abscesses

When the sulfonamides and the antibiotics were introduced, neck infection became infrequent and not difficult to control In the past few years, however, there has been a marked increase in the number of serious neck infections encountered, and the surgical problems they present have returned these troublesome lesions to their former importance The threat of asphyxia is always present as the glottis becomes occluded by edema or exudate Nutritional and fluid balance problems caused by the inability to swallow must be overcome and the presence of sepsis, at times severe, requires careful supportive treatment Extension of the infection into the mediastinum is an ever-present danger The institution of properly timed and adequate surgical drainage requires considerable judgment Cervical abscesses are usually the result of infection in the oropharynx or nasopharynx, particularly the tonsils They also may be dental in origin secondary to dental caries, apical abscesses, or extractions Trauma to the oropharynx or esophagus, either external or incident to endoscopic examination, may result in abscess Less frequent causes are infection in the paranasal sinuses or salivary glands

Retropharyngeal abscess—Abscess of the retropharyngeal space occurs most frequently in infants under 2 years but may be encountered in adults of any age The abscess occupies the space between the posterior pharyngeal wall and the prevertebral layer of the deep cervical fascia It is usually the result of lymphatic extension of nasopharyngeal infection but may be caused by traumatic perforation of the pharynx or esophagus As the abscess increases in size, dyspnea develops and the child's cry becomes high-pitched and nasal Swallowing becomes impossible, with resulting dehydration and malnutrition Examination reveals a tender, fluctuant mass causing a forward bulge of the reddened, edematous posterior pharyngeal wall In abscesses lower in the retropharyngeal area and in the visceral compartment, there may be edema of the epiglottis and arytenoids Complications include carotid sheath involvement, with internal jugular vein thrombosis, aspiration pneumonitis, and severe respiratory obstruction

Ludwig's angina—This severe infection of the submandibular

and submaxillary spaces is most often secondary to dental disease or extraction the lower molar teeth being the common offenders An extensive cellulitis commences in the space between the floor of the mouth and the mylohyoid muscle The infection also involves the submaxillary area between the posterior border of the mylohyoid and the submaxillary gland. Backward extension enters the parapharyngeal space, while forward spread crosses the mid line to invade the opposite submaxillary area Clinically there is a massive, brawny red, edematous, tender swelling in the submental and submandibular region The mucous membrane of the floor of the mouth is swollen and streaked with dirty exudate while the tongue is tremendously enlarged and displaced upward, almost filling the oral cavity Speech is often impossible and there is severe dyspnea and dysphagia The dyspnea may be so severe that immediate tracheostomy is the most pressing requirement

Parapharyngeal abscess—An abscess in the parapharyngeal space develops from acute pharyngitis acute tonsillitis peritonsillar abscess, or dental caries and from backward extension of a submandibular abscess Infections in this space are particularly dangerous because they may spread into the retropharyngeal area or the carotid sheath and down into the mediastinum At times, fascial pockets adjacent to the parapharyngeal space are involved following dental infection The most important of these spaces are those around the masseter and internal pterygoid muscles The most prominent symptom is trismus and this symptom in a patient with sepsis should lead to a careful examination of the neck. There is often a firm, tender swelling in the region of the parotid gland and within the pharynx there is bulging of the tonsil and lateral pharyngeal wall

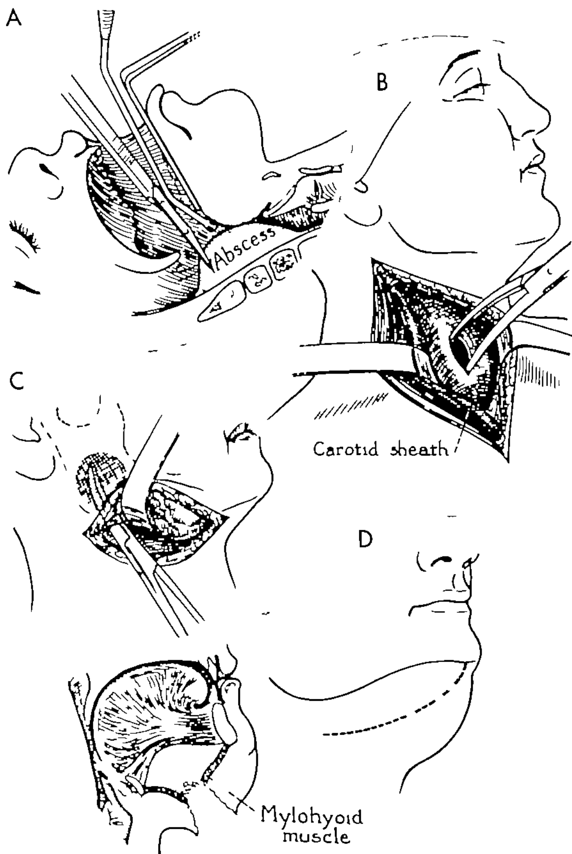
Superficial cervical abscess—Acute superficial cervical adenitis is the most common of all neck infections Frequently occurring in children, the acutely swollen lymph nodes follow middle ear or nasopharyngeal infection At times despite antibiotic therapy suppuration occurs with a resulting superficial red, tender fluctuant mass below the angle of the jaw Incision and drainage at the point of maximal fluctuation is indicated

A — Retropharyngeal abscess The patient is wrapped in a sheet and placed with the head lower than the trunk With the mouth held open and the tongue drawn forward, the posterior pharynx is inspected under good direct light A suction apparatus must be at hand An aspirating needle is inserted into the softest area of the abscess and when pus is obtained, a longitudinal incision is made at the point of aspiration No drain is necessary

B — Visceral space abscess External drainage of the visceral and retropharyngeal spaces may be accomplished by an incision made along the anterior border of the sternocleidomastoid muscle The platysma and superficial layer of the deep cervical fascia are incised and the carotid sheath exposed The common carotid artery, internal jugular vein, and vagus nerve are retracted *laterally* The abscess cavity is opened with a blunt hemostat and the opening enlarged with the operator's finger A Penrose tube drain is inserted into the depth of the cavity and the wound is left open, without suture

C — Parapharyngeal abscess The incision is made in the submaxillary triangle below and parallel to the body of the mandible The submaxillary gland is exposed and retracted upward A blunt hemostat is now directed backward and medial to the internal pterygoid muscle, entering the abscess cavity A Penrose tube drain is introduced into the cavity and sutured into place This incision or one placed directly on the undersurface of the mandible can be used for the drainage of abscesses between the mandible and internal pterygoid muscle or those around the masseter muscle

D — Ludwig's angina A preliminary tracheostomy is often indicated before attempting drainage (see Chapter 4) The incision must be adequate and should extend from 2 cm in front of the angle of the jaw parallel to and 4 cm below the body of the mandible, extending to the midline below the chin The platysma and superficial layer of the deep cervical fascia are incised and the mylohyoid and anterior belly of the digastric muscle exposed These two muscles are divided transversely in the same direction as the skin incision, the mylohyoid being incised from its free posterior border to the midline of the neck, the digastric completely across its anterior belly The entire wound is packed loosely with gauze


A
B
C
D
Abscess
Carotid sheath
Mylohyoid
muscle

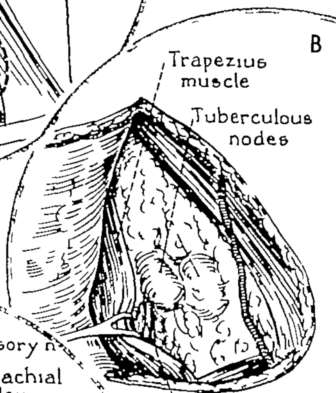
Tuberculosis of the cervical lymph nodes is no longer considered a localized form of the disease but rather part of a generalized infection It is for this reason that excision alone without chemotherapy and bed rest, as formerly practiced, is not recommended Antimicrobial therapy for a minimum of 4 months, with streptomycin or streptomycin and para-aminosalicylic acid, together with rest and sanitarium supervision should precede surgery Residual disease in the cervical lymph nodes following this period of medical treatment should be excised Radical block dissection is not indicated, simple excision of the chain of enlarged lymph nodes is sufficient A persistent sinus following drainage of a tuberculous cervical abscess which does not heal under streptomycin therapy also can be excised successfully

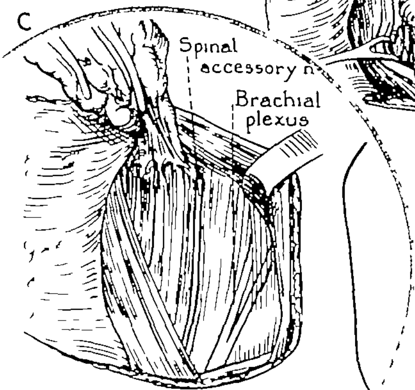
A —The posterior triangle of the neck is a frequent location for tuberculous lymphadenitis Adequate exposure is required for safe excision without injury to the spinal accessory nerve or brachial plexus The incision made through the skin and platysma begins at the mastoid process and continues downward along the mid-portion of the sternocleidomastoid muscle to a point 4 cm above the clavicle Here it curves backward and continues parallel to and above the clavicle to a point slightly back of the anterior border of the trapezius muscle

B —The skin flap is dissected back to the anterior border of the trapezius, thus exposing the chain of enlarged lymph nodes lying in the posterior triangle The next step is the identification of the spinal accessory nerve The nerve is best exposed at the point at which it enters the deep surface of the anterior border of the trapezius approximately 4 cm above the clavicle It lies embedded in fat beneath the superficial layer of the deep cervical fascia Certain identification of the spinal accessory nerve is obtained by noting the sharp contraction of the trapezius when the nerve is gently pinched with a hemostat

C —With identification and protection of the 11th nerve, the chain of lymph nodes lying around it is dissected upward, the branches of the transverse cervical arteries and veins being ligated as encountered After the entire chain of enlarged nodes is removed usually up to the mastoid process, the incision is closed and a small Penrose drain placed in the posterior angle of the wound


A


B
Trapezius muscle
Tuberculous nodes
Spinal accessory nerve


C
Spinal accessory n.
Brachial plexus

2] *Excision of Tuberculous Lymphadenitis*

Tuberculosis of the cervical lymph nodes is no longer considered a localized form of the disease but rather part of a generalized infection. It is for this reason that excision alone without chemotherapy and bed rest as formerly practiced, is not recommended. Antimicrobial therapy for a minimum of 4 months, with streptomycin or streptomycin and para-aminosalicylic acid, together with rest and sanitarium supervision should precede surgery. Residual disease in the cervical lymph nodes following this period of medical treatment should be excised. Radical block dissection is not indicated; simple excision of the chain of enlarged lymph nodes is sufficient. A persistent sinus following drainage of a tuberculous cervical abscess which does not heal under streptomycin therapy also can be excised successfully.

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major lymph channels They are seen most frequently in the neck, either in the upper third or the supraclavicular region but may also involve the mediastinum, chest wall or axilla They are typically bulky soft, easily compressible, nontender masses A cystic hygroma may undergo a rapid increase in size, with encroachment on the upper respiratory passages necessitating a tracheostomy Following upper respiratory infection, a serious infection may develop requiring incision and drainage Attempts at eradication of cystic hygromas by injection of sclerosing solutions have generally failed surgical excision is the treatment of choice

Benign tumors—Among the benign tumors encountered in the neck are lipomas, hemangiomas tumors of peripheral nerves and carotid body tumors Schwannomas arising from nerve sheaths are fairly common in the neck. They are most often found in the brachial plexus, but also are associated with cranial nerves and branches of the cervical plexus Tumors of the carotid body are rare and are seldom diagnosed before surgical exposure They should be suspected when a solitary mass is palpable over the bifurcation of the common carotid artery The mass characteristically can be moved laterally but not vertically in the neck. These tumors are slow growing and may be present for many years

Malignant tumors—Any one of the malignant lymphomas including Brill Symmers disease Hodgkin s disease lymphosarcoma, and reticulum cell sarcoma may appear in cervical lymph nodes Diagnosis is made by open biopsy These diseases may involve the neck as part of a generalized process with widely disseminated tumor or may be present in one or two cervical nodes without evidence of disease elsewhere in the body In the latter instance the successful eradication of the tumor for many years by carefully planned radiotherapy lends support to the theory that at least at times these diseases may have a unicentric origin similar to many other forms of cancer Among other malignant tumors which may arise in the neck are malignant neurinomas and rhabdomyosarcomas We have not been convinced of the validity of the so-called primary branchiogenic carcinomas Most of the so-called branchiogenic cancers if followed carefully will be found to be metastatic from small primary lesions in the nasopharynx, base of the tongue or extrinsic larynx

Lesions Primary in the Neck

In addition to diseases of the thyroid, parathyroid, and salivary glands there are a number of other congenital lesions as well as benign and malignant neoplasms which may arise in the neck Many of these lesions are in characteristic locations and present such typical physical findings that diagnosis is simple Others present difficult diagnostic problems that may be solved only by surgical exposure and microscopic examination

Congenital lesions—A study of the early development of the structures of the neck from the branchial arches and pharyngeal pouches aids in understanding some of the anomalies and vestigial structures which are seen *Thyroglossal cysts and sinuses* are the most common anomalies encountered They are derived from vestiges of the thyroglossal duct connecting the primitive median thyroid to its point of origin on the ventral wall of the pharynx The cysts may appear at any point between the thyroid gland and the foramen caecum at the base of the tongue, they are found most often just below the hyoid bone Although typically a midline lesion, the cysts may be found in a lateral position They are usually 2-4 cm in diameter, nontender, round, cystic lesions

The early development of the branchial arches and intervening clefts may result in the formation of *branchial cleft cysts, sinuses, or fistulas* Branchial cleft cysts occur most frequently in the upper half of the neck beneath the sternocleidomastoid muscle They contain a thin, cloudy fluid which, when obtained on needle aspiration, confirms the diagnosis The presence of a cyst may not be evident until it becomes infected, usually following an upper respiratory infection Branchial fistulas and sinuses are seen less frequently They are usually recognized by their external openings in the skin of the neck along the anterior margin of the lower third of the sternocleidomastoid muscle There is intermittent drainage from the external opening as well as evidence of recurrent infection along the course of the tract If an internal opening is present, it is usually discovered in the pharynx just above the tonsil

Cystic hygromas are multilocular tumor-like lesions originating from primitive lymphatic tissues and often communicating with

major lymph channels They are seen most frequently in the neck, either in the upper third or the supraclavicular region, but may also involve the mediastinum, chest wall, or axilla They are typically bulky soft, easily compressible nontender masses A cystic hygroma may undergo a rapid increase in size with encroachment on the upper respiratory passages necessitating a tracheostomy Following upper respiratory infection, a serious infection may develop requiring incision and drainage Attempts at eradication of cystic hygromas by injection of sclerosing solutions have generally failed surgical excision is the treatment of choice

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Surgical failures after treatment of thyroglossal duct cysts and sinuses are usually due to failure to remove the central portion of the hyoid bone and the extension of the tract into the base of the tongue The tract proceeding cephalad from the cyst is always intimately related to the hyoid, passing through it or immediately above or below the bone This broad central section of the bone must be removed and the tract followed upward to its termination at the foramen caecum

A—The incision, 8 cm in length, extends transversely over the cyst parallel to the hyoid bone

B—Flaps of skin and platysma are elevated, exposing the cyst It may lie above or below the superficial layer of the deep cervical fascia occasionally it lies beneath the pretracheal fascia The inferior and lateral aspects of the cyst are freed Superiorly, dissection proceeds cautiously so that the tract leading upward from the cyst may be identified

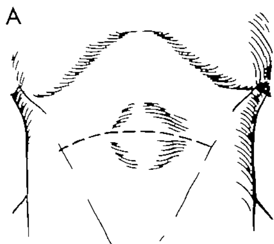
C—Dissection is now carried to the broad central portion of the hyoid bone The bone is drawn forward into the wound and its central portion freed of muscle insertions, using a scalpel or sharp periosteal elevator

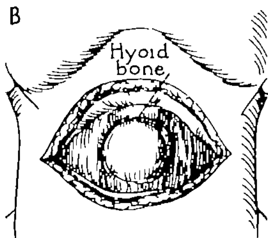
D—The hyoid bone is divided with a bone-cutting forceps on each side of its central part to which the cyst or its tract is attached

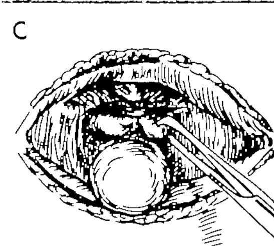
E—The assistant's finger is placed in the patient's mouth and the midline of the base of the tongue is pushed forward toward the operative field A core of muscle tissue of the tongue is excised exactly in the midline, extending from the hyoid bone to the base of the tongue, a surprisingly short distance of about 2 5 cm The specimen consisting of the cyst and the central part of the hyoid bone attached to a core of midline tongue muscle is removed If the pharynx is opened below the base of the tongue, it is closed with a few fine chromic sutures

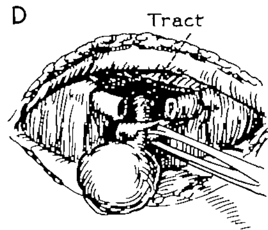
F—The incision is closed by approximating the platysma and the skin around a small rubber drain placed at one angle of the wound It is unnecessary to suture the divided hyoid bone or tongue muscle

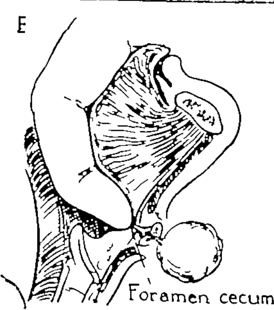
NOTE A thyroglossal duct sinus is removed in exactly the same manner

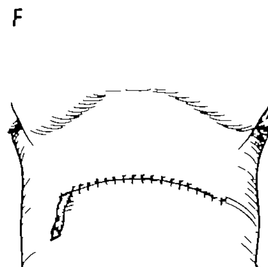

A


B
Hyoid bone


C


D
Tract


E
Foramen cecum


F

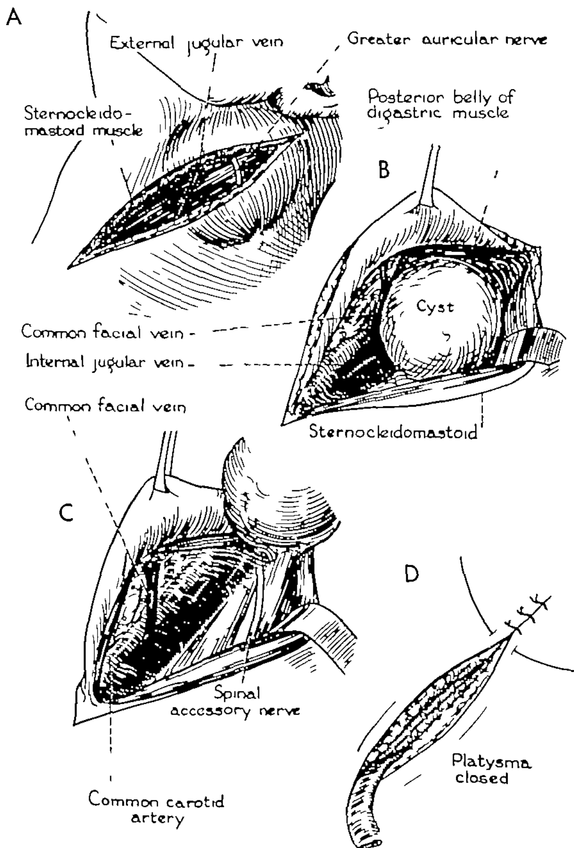
Branchial cleft cysts should be treated by total excision Incision and drainage of the cyst is justified only occasionally as a temporary measure in suppuration Removal of the cyst from its usual location beneath the upper end of the sternocleidomastoid muscle should be a carefully planned procedure, using general endotracheal anesthesia The spinal accessory nerve is needlessly damaged far too often during surgery for branchial cleft cysts This nerve and other important structures around the cyst must be identified and protected

A—The incision is made along the anterior border of the sternocleidomastoid muscle and extends from the tip of the mastoid process downward over the cyst to the middle third of the neck The incision is deepened through the platysma, and skin flaps including platysma are retracted The cyst lies beneath the upper half of the sternocleidomastoid muscle and the fibers of this muscle are stretched over its surface The external jugular vein lies superficial to the cyst and the greater auricular nerve may cross the upper third of the cyst wall

B—The sternocleidomastoid muscle is dissected from the superficial surfaces of the cyst and retracted posteriorly The dissection is now carried close to the cyst wall and is best commenced at its lower angle In this region, the internal jugular vein and the common carotid artery are identified and found to lie on the undersurface of the cyst The common facial vein is closely adherent to the anterior cyst wall All these structures are dissected free and protected The posterior belly of the digastric muscle is now identified

C—The digastric muscle is freed from the deep anterior border of the cyst and the spinal accessory nerve is identified lying on the undersurface of the upper third of the sternocleidomastoid muscle In all cysts in this location, emphasis must be placed on the importance of identifying, isolating, and protecting the spinal accessory nerve

D—Following removal of the cyst, the incision is closed by approximating the platysma with fine cotton or chromic sutures A small Penrose drain is placed in the lower angle of the wound and the skin closed


A
External jugular vein
Greater auricular nerve
Sternocleido-
mastoid muscle
Posterior belly of
digastric muscle
B
Cyst
Common facial vein
Internal jugular vein
Sternocleidomastoid
Common facial vein
C
D
Spinal
accessory nerve
Platysma
closed
Common carotid
artery

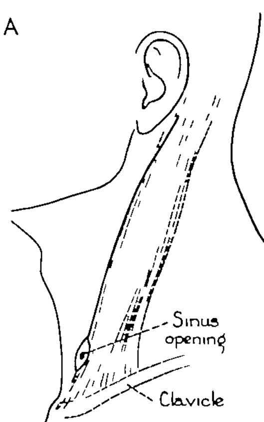
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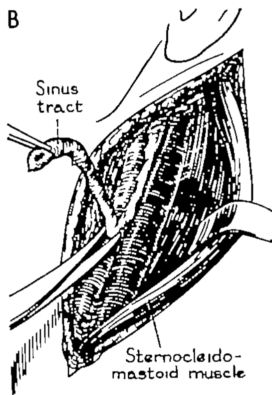
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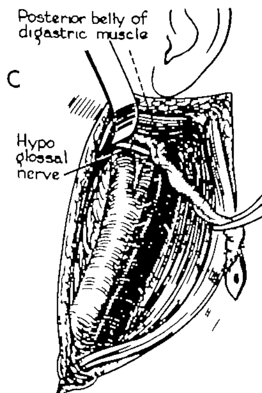
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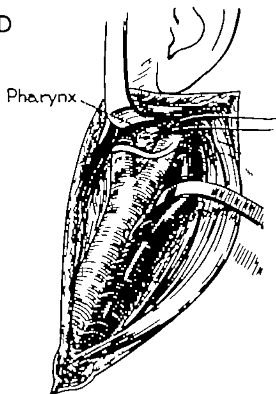
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D—Following removal of the cyst, the incision is closed by approximating the platysma with fine cotton or chromic sutures A small Penrose drain is placed in the lower angle of the wound and the skin closed


A
Sinus opening
Clavicle


B
Sinus tract
Sternocleido-mastoid muscle


Posterior belly of digastric muscle
C
Hypo glossal nerve


D
Pharynx

These anomalous tracts are intimately associated with a number of important landmarks in the neck, including the common carotid artery and its bifurcation the internal jugular vein, the vagus and hypoglossal nerves, and the pharyngeal wall For this reason, wide exposure is mandatory, with positive identification and preservation of related structures as dissection proceeds We prefer the longitudinal incision illustrated rather than the two transverse incisions proposed by others The tract may be a complete fistula with both an internal and an external opening or a long sinus with only an external orifice Rarely, there is an opening into the pharynx with no external outlet

A—The incision is made along the anterior border of the sternocleidomastoid muscle encircling the external opening, which in this patient is 2 cm above the clavicle, and extends upward to the mastoid process The skin flaps, including platysma, are raised and retracted

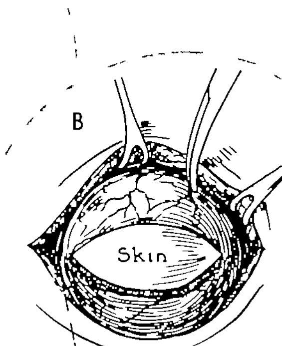
B—The tract is dissected upward along the medial border of the sternocleidomastoid muscle In the middle third of the neck, it lies on the carotid sheath where it is anterior to the common carotid artery and internal jugular vein

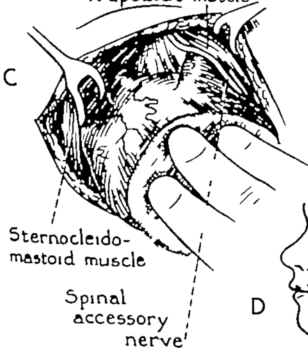
C—Above the carotid bifurcation, the tract lies superficial to the hypoglossal nerve and deep to the posterior belly of the digastric muscle It passes between the external and internal carotid arteries toward the pharynx

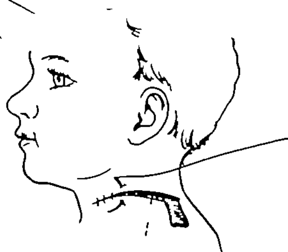
D—The tract is divided at its attachment to the pharynx If a fistula is present, the opening into the pharynx is closed with a layer of fine chromic sutures reinforced by interrupted fine silk The skin flaps are approximated with interrupted fine silk sutures in the platysma and in the skin A small Penrose drain is inserted in the lower angle of the wound

A




B
Skin
Sternocleido-
mastoid muscle


Trapezius muscle
C
Sternocleido-
mastoid muscle
Spinal
accessory
nerve


D
Platysma closed

] *Excision of Cystic Hygroma*

These congenital tumor-like lesions are not simple cysts which may be shelled out of the neck easily They are multilocular structures with long finger-like projections which extend along fascial planes, infiltrate muscle bundles, and surround important structures Surgical excision of cystic hygromas is indicated for an increase in size with encroachment on surrounding structures, for recurrent episodes of infection, and for cosmetic reasons

A —Endotracheal anesthesia must be used An elliptical incision is made over the cyst in line with natural skin creases The amount of skin sacrificed is proportional to the size of the tumor

B —The cyst has a fairly well defined capsule Dissection is carried in the extracapsular plane, and the superficial surface of the mass completely exposed Many small vessels may be seen entering the capsule These are divided and ligated

C —Deep finger-like projections of the lesion extend along fascial planes and often impinge on the carotid sheath These extensions of the tumor are carefully dissected free For adequate exposure, the edge of the sternocleidomastoid is freed, the carotid sheath opened, and its contents identified The spinal accessory nerve also must be exposed and protected during this deep dissection At times, it is difficult or impossible to remove the entire lesion Some of the deep extensions may be severed and secured with transfixion sutures

D —Following removal of the mass, a small Penrose drain is placed in the lower portion of the wound The platysma and skin are approximated separately and a pressure dressing applied

PLATE 69

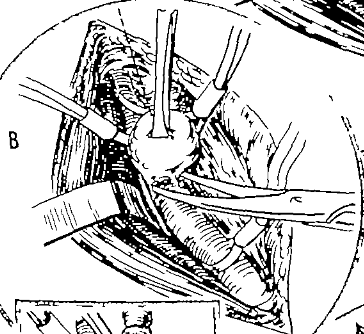
A

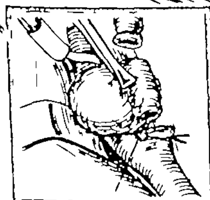
Hypoglossal nerve

Internal jugular vein

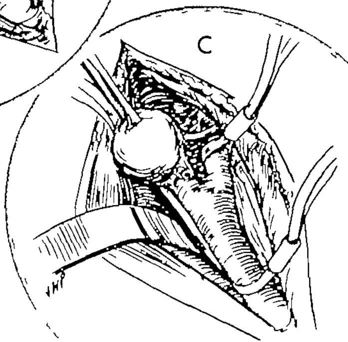
Carotid body tumor

Vagus nerve





Division of external carotid artery



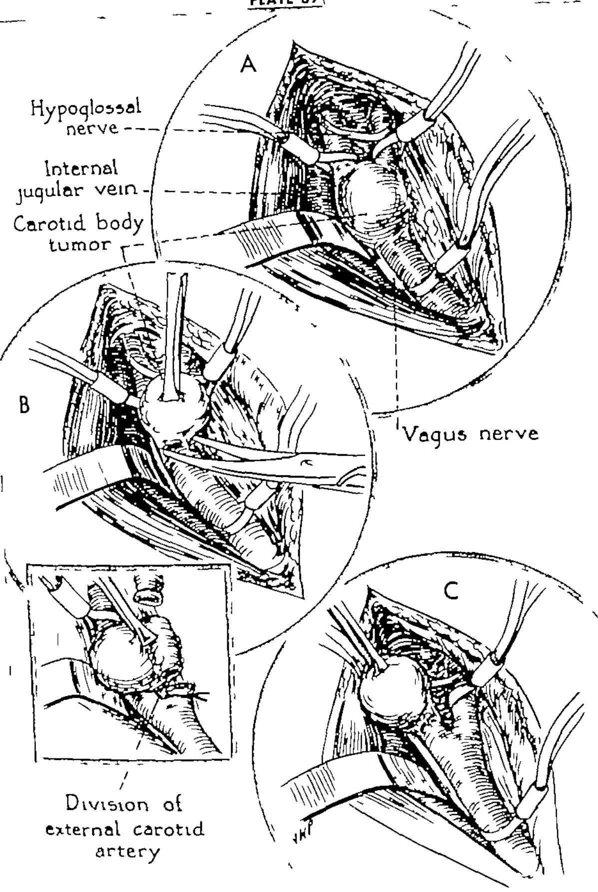
4] *Excision of Carotid Body Tumor*

Carotid body tumors are intimately adherent to the carotid bifurcation, and surgical extirpation is frequently difficult The tumors are often extremely vascular and hemorrhage may become a major problem Adequate exposure during operation is essential Controlling tapes should be placed around the common, external, and internal carotid arteries before removal of the tumor is attempted Because of the high mortality or permanent disability incident to ligation of the common or internal carotid arteries (see Chapter 4) these vessels should not be sacrificed under any circumstances It is preferable to leave some tumor in situ, particularly since most of these neoplasms are benign

A —An oblique incision is made along the anterior border of the sternocleidomastoid muscle Dissection is carried through the platysma and superficial layer of the deep cervical fascia The sternocleidomastoid is retracted laterally, the common facial vein divided, the carotid sheath entered, and the internal jugular vein retracted When the tumor is recognized lying within the fork of the carotid artery, both proximal and distal control of the vessels must be obtained Umbilical tapes are placed around the common, external, and internal carotid arteries but are not tightened If necessary, the skin incision may be extended for adequate exposure The vagus and hypoglossal nerves are identified and protected

B —Dissection is commenced at the lower edge of the tumor immediately on the adventitia of the common carotid If the operator continues close to the wall of the vessel, a good cleavage plane is usually obtained between the vessel and the tumor The tumor is retracted upward and gently freed from the carotid bifurcation by sharp and blunt dissection At times, removal of the mass is facilitated by division of the external carotid between ligatures placed close to its origin (inset)

C —Dissection continues upward on the wall of the internal carotid artery until the tumor has been completely freed If the lumen of the artery is inadvertently entered, control of hemorrhage is obtained by tightening the tapes proximally and distally and repairing the laceration as rapidly as possible with fine arterial silk Following removal of the tumor, a small Penrose drain is placed in the wound and closure of the fascia, platysma, and skin performed


A
Hypoglossal nerve
Internal jugular vein
Carotid body tumor
B
Vagus nerve
C
Division of external carotid artery

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which are selected and adhered to In the standard radical neck dissection, the superior boundary of the excision is the body of the mandible the lower one third of the parotid gland, the roof of the jugular fossa, and the mastoid process The posterior bound ary is the anterior border of the trapezius muscle, and the clavicle forms the inferior limit of the dissection Anteriorly the field in cludes the entire submental space above the hyoid bone and then follows the midline of the neck to the sternal notch Deeply the excision extends to the scalene erector spinae and levator scapulae muscles and above to the mylohyoid muscle The block of tissue removed from the quadrilateral space outlined contains the major lymphatic channels and lymph nodes of the neck, the in ternal jugular vein the spinal accessory nerve the submaxillary and a portion of the parotid salivary glands Also included are the sternocleidomastoid and omohyoid muscles and often the posterior belly of the digastric and the stylohyoid muscles The dissection always proceeds from the periphery of the field and never from its center thus avoiding incision of cancer-containing tissue If the scar of a previous biopsy is present, it should be encompassed by the incision of the neck dissection and should not be crossed Hemostasis should be complete and the ligation of large vessels certain. Small vessels may be coagulated or ligated with fine cotton or catgut Nonabsorbable sutures should be used for large arteries

Special care should be taken in the dissection of certain areas of the field where recurrences have been noted The lymphatic pocket beneath and posterior to the upper one third of the sternocleidomastoid muscle is frequently inadequately cleared. This mass of fatty tissue, containing lymphatic channels and lymph nodes need not be entered if care is taken to keep the plane of dissection beneath the fascia covering the levator angulae scapula and erector spinae muscles These muscles should lie bared of all fascia at the close of the dissection The digastric pocket which lies beneath the mandible and between the posterior belly of the digastric muscle and the pharyngeal wall is another critical area in the dissection. Removal of the posterior belly of the digastric muscle and the stylohyoid muscle is an aid in making possible a clear dissection of this area If gross tumor is present, it is ad

CHAPTER 14

Radical Neck Dissection; Combined Operations

RADICAL NECK DISSECTION is an effective tumor operation which provides the best chance for the eradication of metastatic cervical node cancer arising in malignant lesions of the head and neck The success of this operation is based on the fact that metastases from cancers of the head and neck spread through lymphatic channels and not by way of the blood stream Typically, metastases develop in the cervical nodes near the primary site of the tumor and then progressively invade adjacent nodes, later to extend to the infraclavicular region and the thoracic or right lymphatic ducts The disease remains localized in the neck for long periods, distant dissemination occurring late or not at all

To be successful, a radical neck dissection should be performed in a logical, orderly, and meticulous manner The procedure must be planned so that the cancer field will not be crossed or tumor entered at any time A knowledge of the anatomy of the neck and the location and distribution of the cervical lymph nodes and lymphatic channels is essential The operator should be familiar with the courses of the hypoglossal, vagus, phrenic, glossopharyngeal, and facial nerves, as well as those of the carotid and transverse cervical arteries and the internal jugular and common facial veins Strict attention to fascial planes must be observed to achieve an en bloc dissection while preserving essential structures The operation is designed to remove all the lymphatic, areolar, and muscular tissue in an arbitrarily fixed field, the boundaries of

careful search fails to reveal the primary tumor a neck dissection is performed and the patient re-examined at regular intervals until the primary tumor is discovered There is little evidence to support the theory of branchiogenic carcinoma arising primarily in the neck.

We do not advocate the so-called "prophylactic neck dissection," that is, a neck dissection performed without evidence of cervical node metastases when the neck is not entered for treatment of the primary lesion It is felt that if the patient is carefully followed after treatment of his primary lesion, the cervical node metastasis can be controlled adequately when and if it appears Those who advocate "prophylactic neck dissection" cannot be criticized, provided they devise and follow rational indications for the operation It does not seem logical to perform a neck dissection for *all* cancers of the head and neck, since the likelihood of many of these lesions metastasizing (i e low grade cancer of the lip) is quite remote

Contraindications to radical neck dissection—It is as difficult to define the limits of surgery in this region as it is in many other fields of tumor therapy Considerable judgment based on past experience on the part of the surgeon is often necessary in determining whether a given case lies within the realm of operability Certainly a primary lesion which cannot be controlled, and spread of tumor below the clavicles constitute definite contraindications to surgery Evidence of invasion of the base of the skull or penetration of the prevertebral fascia also generally rules out advisability of neck dissection. Extensive involvement of the skin of the neck by tumor usually indicates incurability despite radical attempts at excision Invasion of the common or internal carotid arteries is often considered a criterion of inoperability However this situation is frequently not evident until a neck dissection is half completed. The surgeon must then decide whether to accept the risk of excision of the carotid artery (see Chapter 4) or to leave a cuff of tumor on the vessel A neck dissection is not indicated in such radiosensitive lesions as lymphosarcoma or metastases from certain nasopharyngeal cancers

Modifications and extensions of radical neck dissection—The standard operation described in this chapter is frequently modi

visable to ligate and divide the external carotid artery and remove it and its branches in continuity with the contents of the pocket Finally, recurrences take place in the lower one third of the parotid gland These can be avoided if the line of dissection is carried across the tail of the parotid, removing the lower 3 cm of the gland with its contained lymph nodes

Indications for radical neck dissection—The major indication for radical neck dissection is the presence of cervical node metastasis from a cancer of the head and neck which is controlled or which has a reasonable chance of being controlled Often, when a known primary cancer and a firm, enlarged cervical node are present, the diagnosis of cervical metastasis is evident and no histologic proof of metastatic cancer need be obtained before proceeding with a neck dissection At times, an aspiration biopsy is indicated to establish the diagnosis before proceeding with surgery (see Chapter 2) Occasionally, with the primary cancer known to be controlled for a long period, a slightly enlarged node should be excised and a frozen section diagnosis obtained before neck dissection

A second indication for radical neck dissection is when the mandible must be divided for access to the primary lesion (i e, base of tongue) or resected with the primary lesion (i e, gum) As emphasized by Hayes Martin, division or resection of the mandible necessitates entering the upper cervical region Since the surgical field extends into the neck, this moment is the propitious time to proceed with a neck dissection If the operation is deferred and necessitated by future developments, it will be more difficult and less effective because of scarring and obliteration of normal fascial planes in the neck This same principle of neck dissection at the time of treatment of the primary tumor is applied to treatment of cancer of the thyroid, extrinsic larynx, and hypopharynx, since excision of these tumors also involves opening cervical planes

A third indication for the operation is the presence of metastatic epidermoid cancer in the upper neck with no evident primary lesion Experience has demonstrated that in most instances an occult primary lesion is present, usually in or around Waldeyer's ring, and that it will become evident some time in the future If

lymph node metastases The operation is generally staged, one side of the neck being operated on at a time In some situations however as when a large portion of the mandible is to be resected or a laryngectomy is to be performed, it is technically easier and better cancer therapy to perform a one-stage bilateral neck dissection in continuity with excision of the primary lesion We have done this on a number of occasions without mortality Fear of completely blocking the venous return from the brain by this extensive removal of vascular channels is unwarranted Adequate venous return is provided by the large vertebral venous system However when a simultaneous bilateral neck dissection or a second neck dissection is performed, a prophylactic tracheostomy is a good safety measure since the lymphedema so common in the face after bilateral dissection may also temporarily involve the larynx (see Chapter 4)

Combined Operations

When the cancer in its primary site is treated surgically and a neck dissection is indicated, the two procedures are usually done simultaneously Thus many intra-oral cancers as well as lesions of the hypopharynx, larynx, parotid, thyroid and cervical esophagus may be removed in one stage with a radical neck dissection In the case of intra-oral cancer the mandible may or may not be resected with the primary lesion and neck contents, depending on whether it is involved by the tumor (see Chapters 8 and 10) It is generally possible to perform the combined removal of the primary lesion and the neck contents in continuity this is of theoretical value in cancer surgery At times however as in lesions of the base of the tongue an in-continuity excision is not readily feasible and the primary tumor and cervical nodes are removed separately although at the same stage

Patients with tand operations of the magnitude of those described in this chapter extremely well if the principles of care described in Chapters 3 and 4 are followed The small number of operative deaths that occur are generally due to coexistent heart disease or cerebral vascular accidents

[Technic of radical neck dissection on page 254]

fied to meet the many variations in which metastatic cervical cancer may occur While the platysma muscle is generally left attached to the skin flaps with complete safety, the skin should be dissected away from the platysma whenever metastatic nodes lie immediately beneath this muscle or are attached to it Wide areas of skin also are sacrificed if tumor impinges close to the skin Any of the nerves encountered in the course of a neck dissection may be excised safely if involved by metastatic cancer (see Chapter 4, Nerve Injury) The field of the block excision is widened at times to encompass metastatic disease with a safe margin of normal tissue Thus, when there is extensive disease in the posterior triangle of the neck, the lateral portion of the dissection is commenced far posteriorly instead of at the border of the trapezius When nodes in the submandibular region are attached to the periosteum of the mandible, the surgeon should not hesitate to remove a longitudinal segment of the mandible with a bone saw in continuity with the neck contents On rare occasions, one may be justified in extending dissection into the mediastinum to clear safely disease in the lower neck

Various partial or incomplete neck dissections have been proposed in the past These include so-called "upper neck dissections," supraomohyoid dissections, and procedures in which the internal jugular vein or the spinal accessory nerve is preserved We are generally opposed to these operations because a field potentially containing cancer is entered and cut across, and because a later more complete neck dissection is likely to be difficult and ineffective in the scarred field In those situations in which the primary lesion is in the midline of the lip or floor of the mouth, a complete neck dissection is performed on the side with clinically evident metastases, and only the submaxillary and digastric areas entered and cleared of their contents on the opposite side Should microscopic examination of the limited tissue removed from this side show metastatic cancer, a radical neck dissection should be performed Whenever cancer is found in the tissues of a limited neck dissection, experience has shown that a complete radical dissection is indicated

Bilateral radical neck dissection—Complete neck dissection is not infrequently required on each side of the neck for bilateral

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[Technic of radical neck dissection on *page 254*]

Both superficial and deep groups of lymph nodes connected by a complex system of lymphatic vessels drain the head and neck The lymphatic collecting systems terminate in the right and left jugular trunks which empty into the thoracic and right lymphatic ducts or may empty independently into the subclavian veins There is no direct connection between the cervical and mediastinal lymphatics

Various classifications of single cervical nodes and chains of nodes are to be found For clinical purposes, the nodes may be divided into a number of regional groups The *submental* nodes lie within the triangular space formed by the anterior bellies of the digastric muscle and the hyoid bone They receive lymphatics from the lower lip and anterior floor of the mouth The *submandibular* nodes form an important group lying within the digastric triangle close around the submaxillary salivary gland They drain the face and the major portion of the oral cavity *Parotid* nodes include a group lying around and within the parotid salivary gland These nodes drain the scalp, ear, and a portion of the face as well as the parotid gland itself *Postauricular* nodes over the origin of the sternocleidomastoid muscle also drain the ear and scalp

The most important deep cervical lymph nodes lie in close relationship to the internal jugular vein and may arbitrarily be divided into upper, middle, and lower groups of *jugular* nodes A node in the upper jugular group known as the *subdigastric* node is often the primary site of drainage from the tonsil, pharyngeal wall, and base of the tongue A group of both superficial and deep nodes in the posterior triangle of the neck lie in close proximity to the spinal accessory nerve and also around the external jugular vein and in the supraclavicular region They may be grouped together for clinical purposes as the *accessory chain* or the posterior triangle nodes

Small nodes of importance in dealing with the thyroid and larynx lie near the midline of the neck anteriorly and are known as *prelaryngeal* and *pretracheal* nodes

Parotid nodes
Postauricular nodes
Submandibular nodes
Submental nodes
Jugular nodes
Prelaryngeal node
Pretracheal nodes
Accessory chain

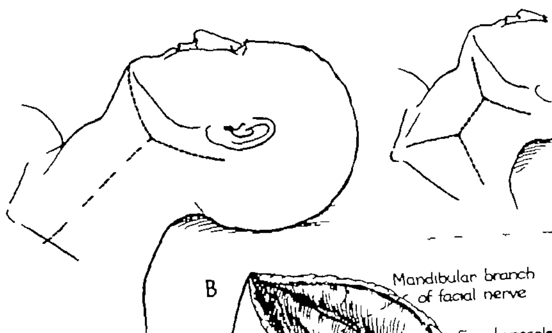
A.—Endotracheal anesthesia is used. The patient is placed on the operating table with his head in moderate extension and rotated away from the operator. The Y-shaped incision allows satisfactory exposure and is the one we generally prefer. A curved upper incision is carried from the mastoid process to the midpoint of the chin, the mid-portion of the incision is about 3 cm. below the inferior border of the mandible. A vertical extension is carried from the mid-portion of this incision down the lateral aspect of the neck and crosses the center of the clavicle a distance of 3 cm. The trifurcate incision (inset) gives equally satisfactory exposure, however, an additional intersection is formed with the possibility of necrosis at the angles.

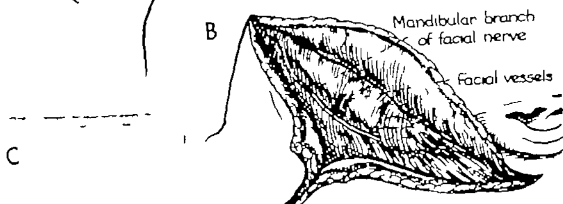
B.—The upper curved incision is made through the skin and platysma. As the upper skin flap is retracted, the ramus marginalis mandibulae of the facial nerve is identified lying on the deep fascia. It is most easily found at the point where it crosses the facial vessels just below the edge of the mandible. If no gross cancer is present along its course, the nerve is preserved by reflecting it upward with the flap of skin and platysma. The flap is dissected a distance of 2 cm. above the inferior border of the mandible.

C.—The vertical portion of the incision is made and flaps of skin and platysma are reflected anteriorly and posteriorly to expose the entire lateral region of the neck and the clavicle below. The anterior flap is raised until the anterior midline of the neck is reached. Posteriorly, the platysma thins out and disappears, and fibers of the upper portion of the sternocleidomastoid muscle are attached to the skin. Dissection is continued just beneath the skin until the anterior margin of the trapezius muscle is exposed. As the flaps are raised, branches of the anterior and external jugular veins are severed, the veins themselves being left in situ to be removed with the block excision.

[Radical neck dissection *continued on page 256*.]

PLATE 71


A


B
Mandibular branch of facial nerve
Facial vessels

C
Anterior jugular vein
Sternocleido-mastoid muscle
Trapezius muscle
External jugular vein

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B—The upper curved incision is made through the skin and platysma. As the upper skin flap is retracted, the ramus marginalis mandibulae of the facial nerve is identified lying on the deep fascia. It is most easily found at the point where it crosses the facial vessels just below the edge of the mandible. If no gross cancer is present along its course, the nerve is preserved by reflecting it upward with the flap of skin and platysma. The flap is dissected a distance of 2 cm. above the inferior border of the mandible.

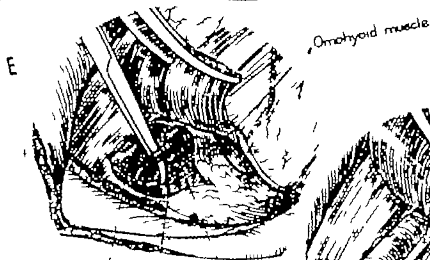
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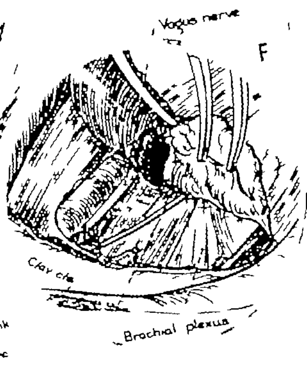
[Radical neck dissection *continued on page 256*.]

PLATE 71

D

Trapezius muscle
External jugular vein
Carotid sheath
Omohyoid muscle
Superficial layer of deep cervical fascia
Clavicle





D—Block dissection of the deep structures of the neck is now commenced The sternal and clavicular attachments of the sternocleidomastoid muscle are severed at a point 1 cm above the clavicle, care being taken to protect the underlying carotid sheath Dissection is then carried posteriorly along the clavicle by incising the superficial layer of the deep fascia The external jugular vein is exposed and divided near the midpoint of this incision Laterally, the omohyoid muscle is encountered and is severed just above its scapular attachment where it meets the anterior edge of the trapezius muscle This point is the posterior corner of the block dissection

E—The carotid sheath is entered about 1 cm above the clavicle The internal jugular vein is isolated at this point by careful blunt dissection The vein is divided between ligatures, care being taken to avoid injury to the vagus nerve, which lies immediately adjacent to its posteromedial surface After division of the vein, its lower end is additionally secured with a transfixion suture The thoracic duct often may be identified just lateral and inferior to the point of division of the jugular vein on the left side of the neck

F—The common carotid artery and vagus nerve are identified within the carotid sheath The anterior portion of the sheath is elevated a short distance Dissection is once again carried laterally through the fatty areolar tissue of this deep plane to outline the lower limits of the block excision As dissection proceeds from the carotid artery outward, three important structures are encountered The thyrocervical artery trunk or its transverse cervical branch must be divided and ligated just lateral to the carotid sheath The phrenic nerve (and occasionally an accessory phrenic nerve) is noted coursing downward in an oblique direction from the posterior toward the anterior edge of the scalenus anterior muscle and is preserved Near the outer third of the clavicle, the brachial plexus is seen in the same plane as the scalene muscles The fatty and areolar tissue overlying the brachial plexus is continuous with the contents of the axilla This tissue is transected at the lower outer corner of the operative field (see *D* above), branches of the transverse cervical vessels encountered being clamped and ligated

[Radical neck dissection *continued on page 258*]

PLATE 71

D

Trapezius muscle

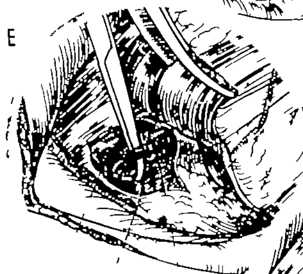
Carotid sheath

External jugular vein

Clavicle

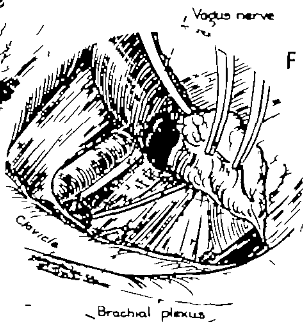
Omohyoid muscle

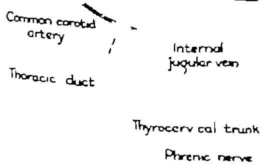
Superficial layer of deep cervical fascia



Omohyoid muscle

Vagus nerve



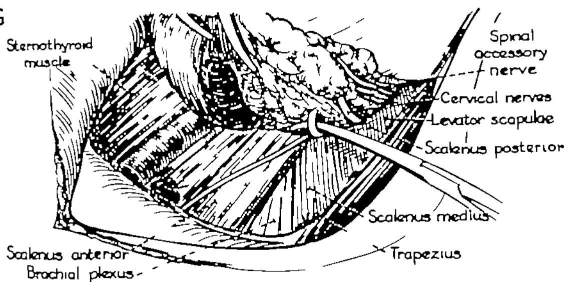


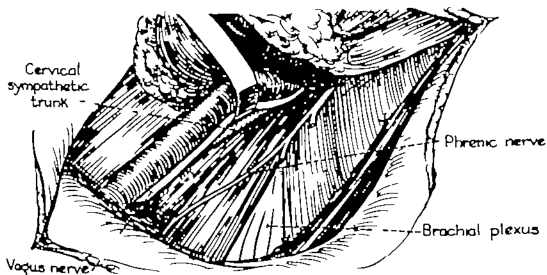
G—Once the lower limit of the operative field has been delineated, attention is directed to the posterior triangle of the neck Dissection commences at the anterior margin of the trapezius muscle and this is cleared upward From this landmark, dissection is continued medially just superficial to the brachial plexus and the levator scapulae, and the scalene muscles Numerous anastomotic branches of the transverse cervical and suprascapular arteries are encountered in this region and must be secured No attempt is made to preserve the spinal accessory nerve To do so would necessitate entering a plane potentially containing cancer As the nerve is severed, one notes a sudden contraction of the trapezius and levator scapulae As dissection proceeds medially in the excellent fascial plane forming the floor of the posterior triangle, branches of the cervical nerves are encountered emerging from the deep structures of the neck and curving superficially into the tissues being removed Care should be taken to sever the branches of the 5th and 6th cervical nerves peripheral to the origin of the phrenic nerve from them

H—Dissection passes over the phrenic nerve, and the carotid artery and vagus nerve are again exposed The anterior and lateral portions of the carotid sheath are dissected upward with the sternocleidomastoid, the internal jugular vein and surrounding lymphatic and areolar tissue The cervical sympathetic trunk is identified in its position just lateral and posterior to the common carotid artery

I—The anterior portion of the block dissection may now be completed rapidly by incising the superficial layer of the deep cervical fascia just lateral to the sternohyoid muscle The anterior margin of the anterior belly of the omohyoid muscle forms an excellent landmark for this incision The muscle is followed upward and is finally severed at its attachment to the hyoid bone It is advisable at this point to review the entire field, ligate bleeding vessels, remove all hemostats, and cover the dissected area with fresh warm pads

[Radical neck dissection *continued on page 260*]


G
Sternothyroid muscle
Spinal accessory nerve
Cervical nerves
Levator scapulae
Scalenus posterior
Scalenus medius
Scalenus anterior
Trapezius
Brachial plexus


H
Cervical sympathetic trunk
Phrenic nerve
Brachial plexus
Vagus nerve


Sternohyoid muscle
Omohyoid muscle

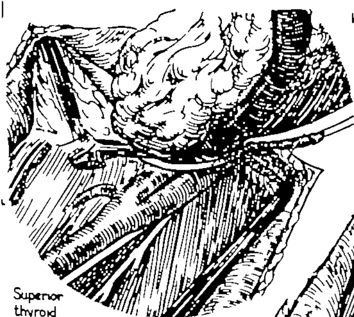
J—Dissection proceeds cephalad and the sternocleidomastoid muscle is severed at the mastoid process and retracted anteriorly This allows further upward exposure of the carotid artery and its bifurcation Dissection of the sheath over the bifurcation of the artery may in some patients incite a carotid sinus reflex evidenced by bradycardia and hypotension The reflex effects can be controlled by infiltration of the adventitia of the artery at its bifurcation with 1% procaine The hypoglossal nerve is identified as it crosses the external and internal carotid arteries and curves forward beneath the posterior belly of the digastric muscle

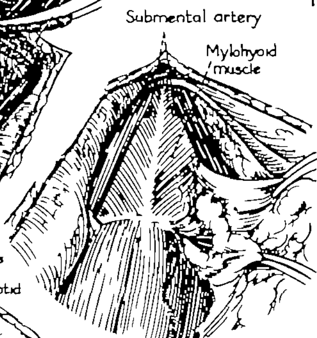
K—The submental space is then cleared from above downward Dissection is carried between the two anterior bellies of the digastric muscles and directly on the surface of the mylohyoid muscle The fatty-areolar tissue and lymph nodes forming the contents of the submental space are dissected downward to the hyoid bone and laterally to the side of the operative specimen

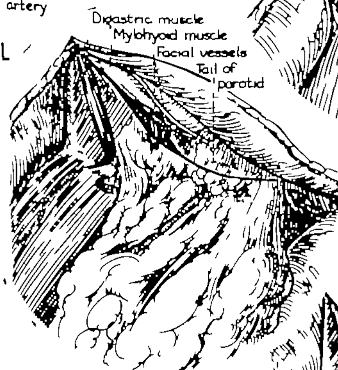
L—The upper limit of the dissection to be performed is now defined by incising the deep fascia directly on the lower free edge of the mandible This incision commences anteriorly at the insertion of the digastric muscle At the midpoint of the mandible, the facial vessels are divided and ligated As the angle of the mandible is approached, the tail of the parotid gland is encountered The incision is carried directly across this portion of the parotid to the mastoid process The external jugular vein and the anterior division of the posterior facial vein are divided within the parotid

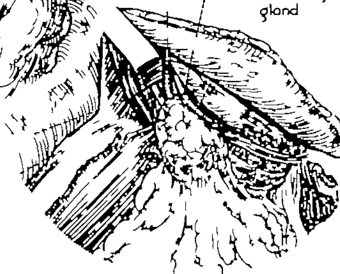
M—The submaxillary triangle is next entered, commencing dissection along the anterior belly of the digastric muscle and proceeding posteriorly on the surface of the mylohyoid muscle When the free posterior border of the mylohyoid muscle is reached, it is retracted anteriorly to expose the submaxillary salivary gland lying on the hyoglossus muscle The hypoglossal nerve surrounded by the two lingual veins is seen crossing the hyoglossus beneath the gland The gland is gently retracted downward away from the mandible, exposing the lingual nerve The small branch from the lingual nerve to the submaxillary gland is divided

[Radical neck dissection *continued on page 262*]


Hypoglossal nerve
Mastoid process
Superior thyroid artery


K
Submental artery
Mylohyoid muscle

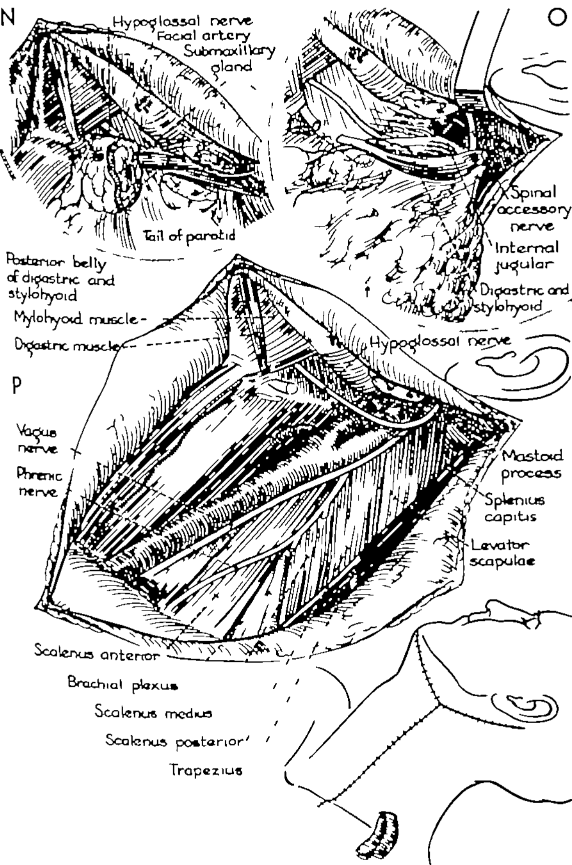

L
Digastric muscle
Mylohyoid muscle
Facial vessels
Tail of parotid


Submaxillary duct
M
Lingual nerve
Submaxillary gland
Mylohyoid muscle
Hypoglossal nerve

N—The submaxillary duct is identified coursing inferior to the lingual nerve The lingual nerve must be seen before division of the duct to avoid section of the nerve by error The duct is divided and ligated The gland, with surrounding fatty-areolar tissue and lymph nodes, is dissected posteriorly and inferiorly toward the posterior belly of the digastric muscle As the dissection of the submaxillary triangle is completed, the last structure encountered is the facial branch of the external carotid artery This vessel enters the triangle beneath the posterior belly of the digastric muscle and is applied closely to the posterior surface of the submaxillary gland The vessel is divided just above the edge of the digastric muscle For the best exposure of the digastric area, it is advisable to divide the posterior belly of the digastric and stylohyoid muscles at the hyoid bone and reflect them backward to their attachments on the mastoid where they are again divided

O—The upper end of the internal jugular vein must now be divided The vein is exposed by elevating or reflecting the posterior belly of the digastric muscle and carefully dividing the loose fascial envelope surrounding the vein beneath the muscle The proximal portions of the hypoglossal and vagus nerves are once more identified and protected The vein is divided opposite the palpable prominence of the transverse process of the atlas As the vein is divided and ligated, the upper portion of the spinal accessory nerve is visualized and severed, thus removing the last attachment of the operative specimen

P—The entire wound is inspected for hemostasis, after which it is irrigated with saline solution Two Penrose drains are placed in the wound, one directed anteriorly and the other posteriorly The drains may be brought out through the lower angle of the wound or through a stab wound in the lateral skin flap The flaps are then approximated with buried sutures in the platysma and interrupted sutures of fine silk in the skin A bulky pressure dressing is applied to the neck (see Dressings, Chapter 3)

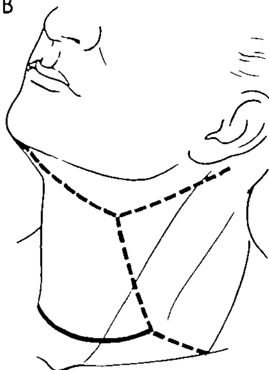

N
Hypoglossal nerve
Facial artery
Submaxillary gland
Tail of parotid
O
Spinal accessory nerve
Internal jugular
Digastric and stylohyoid
Posterior belly of digastric and stylohyoid
Mylohyoid muscle
Digastric muscle
Hypoglossal nerve
P
Vagus nerve
Phrenic nerve
Mastoid process
Splenius capitus
Levator scapulae
Scalenus anterior
Brachial plexus
Scalenus medius
Scalenus posterior
Trapezius

N—The submaxillary duct is identified coursing inferior to the lingual nerve The lingual nerve must be seen before division of the duct to avoid section of the nerve by error The duct is divided and ligated The gland, with surrounding fatty-areolar tissue and lymph nodes is dissected posteriorly and inferiorly toward the posterior belly of the digastric muscle As the dissection of the submaxillary triangle is completed, the last structure encountered is the facial branch of the external carotid artery This vessel enters the triangle beneath the posterior belly of the digastric muscle and is applied closely to the posterior surface of the submaxillary gland The vessel is divided just above the edge of the digastric muscle For the best exposure of the digastric area, it is advisable to divide the posterior belly of the digastric and stylohyoid muscles at the hyoid bone and reflect them backward to their attachments on the mastoid where they are again divided

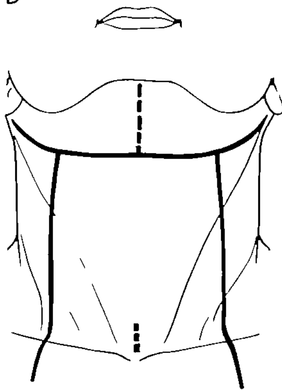
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A


B


C


D

Incisions for Combined Operations

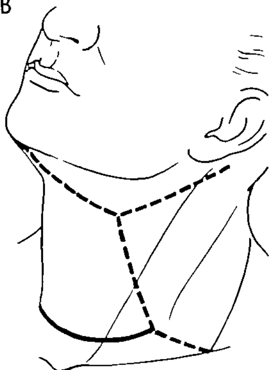
A.—Wide exposure of the oral cavity, particularly its posterior portion, requires reflection of either an upper or lower cheek flap with division of the upper or lower lip. The upper cheek flap (Fergusson incision, Chapter 9) is most generally used for an approach to the upper gingiva, palate, or paranasal sinuses. The lower cheek flap illustrated is reflected for exposure of the mandible, tongue, floor of mouth, and tonsillar region, particularly when excision of a tumor of these structures is to be combined with a radical neck dissection. The anterior arm of the incision for a neck dissection is continued vertically across the midline of the chin and the lower lip. The cheek flap is then reflected laterally by incision of the mucosa in the gingivobuccal gutter and subperiosteal dissection along the body of the mandible. If the mandible is to be preserved, a narrow strip of mucosa must be preserved along the gingiva for approximation to the buccal mucosa at the close of the operation. If the mandible is to be removed, the mucosal incision may be carried closer to the gingiva, for the buccal mucosa will then be approximated to the floor of the mouth or tongue at the time of wound closure.

B.—Radical neck dissection may be decided on at the time of thyroidectomy or at some later period. The extension of the usual collar incision illustrated affords good exposure. The upper part of the neck dissection incision is outlined in the usual manner. At the point where the vertical arm joins the collar incision, an extension is carried laterally and inferiorly until it reaches the clavicle opposite the anterior margin of the trapezius muscle.

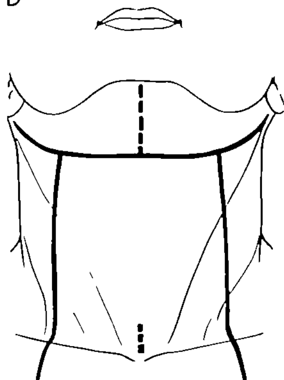
C.—The incision used for parotidectomy (Chapter 11) may be extended for a radical neck dissection should a combined procedure be decided on. The cervical portion of the parotid incision is carried anteriorly to the midpoint of the chin. The vertical arm of the neck incision is constructed in the usual manner.

D.—This incision has proved effective for performance of a one-stage bilateral radical neck dissection. The upper horizontal incision is carried from one mastoid process to the other about 4 cm. below the inferior margin of the mandible. A vertical arm is outlined on each side of the neck as for a unilateral neck dissection. A temporary tracheostomy is always used following the one-stage bilateral dissection.


A


B


C


D

] **Combined Operation with Resection of Mandible**

This is the treatment of a typical carcinoma of the floor of the mouth with invasion of the body of the mandible and the adjacent side of the tongue A generally similar operation is performed for carcinoma of the gum and for extensive lesions of the tongue extending into the floor of the mouth to the mandible

A —A radical neck dissection has been performed in the usual manner except that the digastric triangle has not been cleared The neck contents remain attached to the lower border of the mandible and the submaxillary salivary gland The lower lip is split in the midline and a cheek flap is elevated by an incision in the gingivo-buccal gutter and dissection along the body of the mandible (In some situations, adequate exposure may be obtained without reflection of the cheek flap The surgeon may expose the mandible and the intra-oral lesion from below without dividing the lower lip)

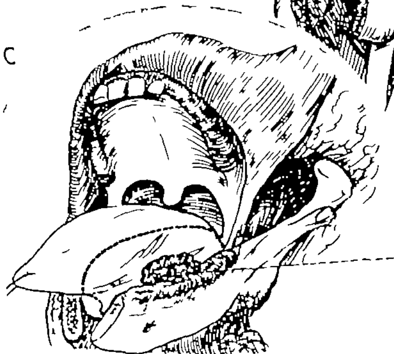
B —A pharyngeal pack is inserted to prevent aspiration of blood The mandible is divided well anterior to the lesion with a Gigli saw If the patient is not edentulous, one or two teeth must be extracted before the mandible is divided Posteriorly, the mandible is disarticulated at the temporomandibular joint At times, when there is little possibility that the tumor has invaded the medullary canal, the mandible may be sectioned at the angle and the anterior and posterior fragments later stabilized with a steel pin (see Chapter 10)

C —Once the segment of mandible has been freed posteriorly, an incision is outlined around the tumor, leaving at least 1 5 cm of normal mucosa on all its edges The incision is carried through the deep musculature of the tongue and the floor of the mouth The lingual nerve is sacrificed, the lingual artery is divided and ligated If more than the lateral edge of the tongue is involved, the hypoglossal nerve is also severed in the block excision The intra-oral tumor and mandible have now been freed from all attachments above

[Combined operation with resection of mandible *continued on page 268*]


A

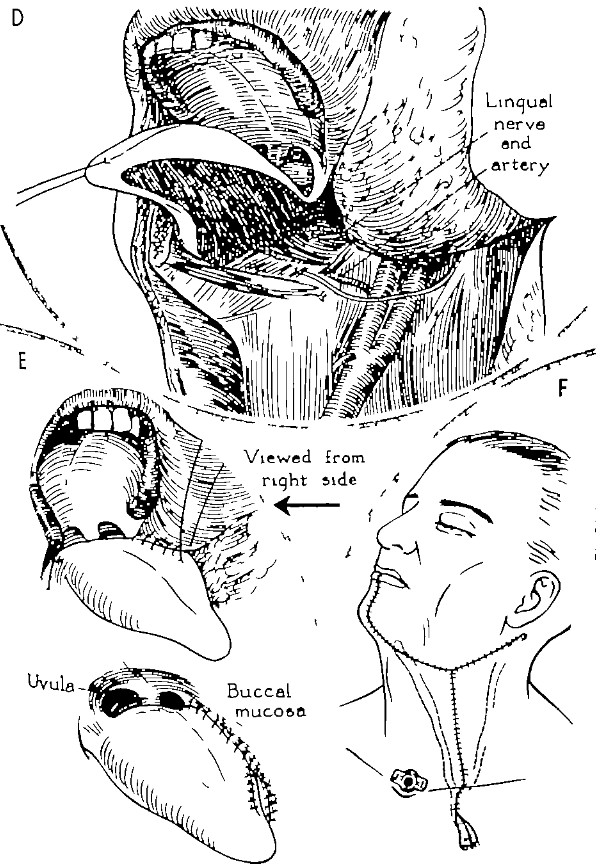

B


C
Tumor invading mandible

D—The intra-oral tumor, the attached segment of mandible, and the neck contents are removed en masse Hemostasis is obtained by ligating all bleeding vessels with ties of fine chromic catgut The wound is thoroughly irrigated with saline solution

E—Closure of the oral cavity is effected by approximating the edge of the tongue to the incised edge of buccal mucosa This is commenced posteriorly The mucosal edges are joined with interrupted sutures of 4-0 silk, the knots being tied within the mouth To prevent a leak, this suture line must be reinforced by deep sutures wherever possible This is accomplished by suturing the muscle of the tongue to the deep surface of the cheek flap with interrupted sutures of 3-0 chromic catgut Anteriorly, the buccal mucosa is sutured to the remnant of the mucosa of the floor of the mouth The wound near the tip of the tongue is repaired with interrupted silk sutures, leaving a short mobile segment of tongue Silk sutures are used for all intra-oral suture lines except for those sites where the sutures may be inaccessible through the open mouth for removal postoperatively In such areas, usually near the base of the tongue, the mucosal edges are approximated with interrupted sutures of 2-0 chromic catgut

F—The lip is reconstructed with buried chromic sutures in the orbicularis muscle and fine silk sutures in the skin and mucosa Care is taken to align accurately the vermilion-skin junction The pharyngeal pack is removed The neck wound is drained and closed in the usual manner A tracheostomy is performed at the conclusion of the procedure and a bulky pressure dressing applied


D
Lingual
nerve
and
artery
E
F
Viewed from
right side
Uvula
Buccal
mucosa

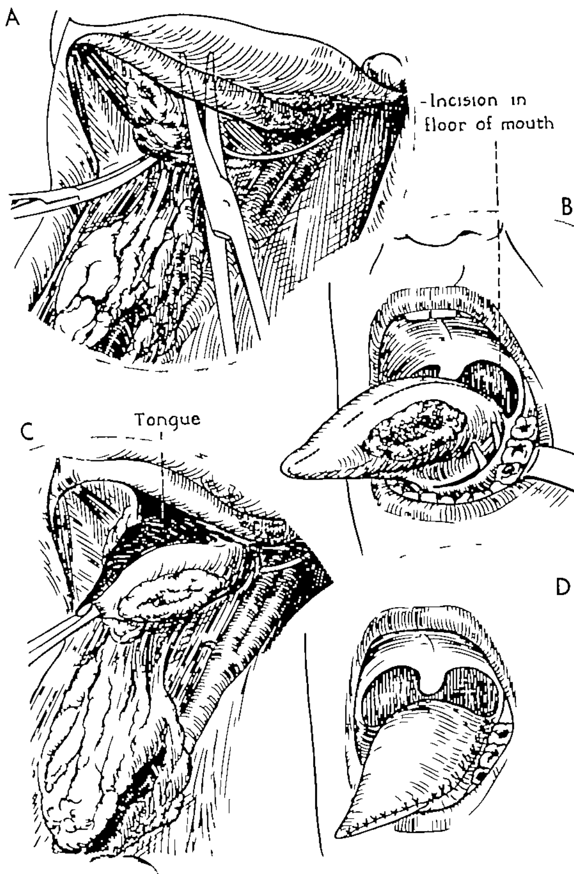
When the primary intra-oral lesion is limited to the tongue, a combined type of operation is often feasible without resection of the mandible There must be little or no extension of tumor into the floor of the mouth in the case suitable for this procedure, otherwise closure of the intra-oral wound is difficult

A —Neck dissection is completed, except for the contents of the digastric triangle The specimen of the neck dissection remains attached to the submandibular tissues The inner aspect of the body of the mandible is freed by dissection close to the bone

B —A pharyngeal pack is inserted Dissection is carried upward beneath the body of the mandible, and the floor of the mouth is entered midway between the mandible and the side of the tongue The incision in the floor of the mouth is lengthened anteriorly and posteriorly, skirting the lesion of the tongue by at least 1 5 cm The tongue is divided longitudinally at or beyond the midline The posterior extent of this incision is curved laterally well behind the tumor to join the incision in the floor of the mouth

C —The portion of tongue containing the tumor is pulled downward into the neck Incision of the deep muscles of the tongue is continued The lingual artery is divided and secured The lingual and hypoglossal nerves are sacrificed The tongue is removed still attached to the submaxillary and sublingual glands and in continuity with the neck dissection

D —Closure of the intra-oral wound is accomplished by approximating the cut edges of the tongue to the mucosa of the floor of the mouth with vertical mattress sutures of 4-0 silk This suture line is reinforced with buried sutures of chromic catgut Anteriorly, the dorsal and ventral incised edges of the tongue are approximated The neck is drained and closed in the usual manner A tracheostomy may be indicated if excision has included a portion of the base of the tongue


A
-Incision in floor of mouth
B
Tongue
C
D

Carcinoma of Base of Tongue or Tonsil

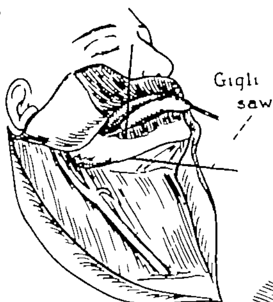
When the decision has been made to treat cancers of the base of the tongue, the soft palate, or the tonsillar region surgically, a neck dissection is always performed, since adequate exposure of these sites requires division and often excision of the mandible It is difficult to perform an in-continuity excision of these lesions The neck contents are generally removed before attack on the primary site In some tumors of the base of the tongue, it is possible to preserve the mandible as shown here For adequate excision, tonsillar lesions usually must be removed in continuity with the ascending ramus of the mandible

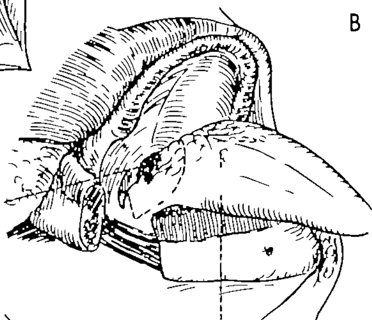
A —A complete radical neck dissection has been performed A cheek flap is raised by division of the lower lip and incision in the gingivobuccal gutter as far as the retromolar region The mandible is divided with a Gigli saw well anterior to the site of the tumor

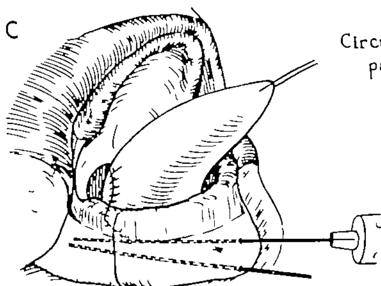
B —Forward traction on the tongue and retraction of the ends of the mandible will give adequate exposure of the base of the tongue An incision is started in the floor of the mouth at the point of division of the mandible and carried into the base of the tongue The tumor is excised with a wide margin of normal mucosa and underlying muscle

C —Closure is commenced by approximating the remaining portions of the base of the tongue, using many interrupted sutures of 2-0 chromic catgut The mucosal suture line is reinforced by deep chromic sutures through the muscle of the tongue The mandibular fragments are approximated and fixed with one or two Kirschner wires drilled across the fracture site Closure of the gingivobuccal gutter is accomplished with interrupted mucosal sutures of fine silk More extensive lesions of the base of the tongue require the management outlined on page 274

[Carcinoma of base of tongue or tonsil *continued on page 274*]


A
Gigli
saw


B
Tumor of
base of
tongue
Circumvallate
papillae


C
Repair of
mandible

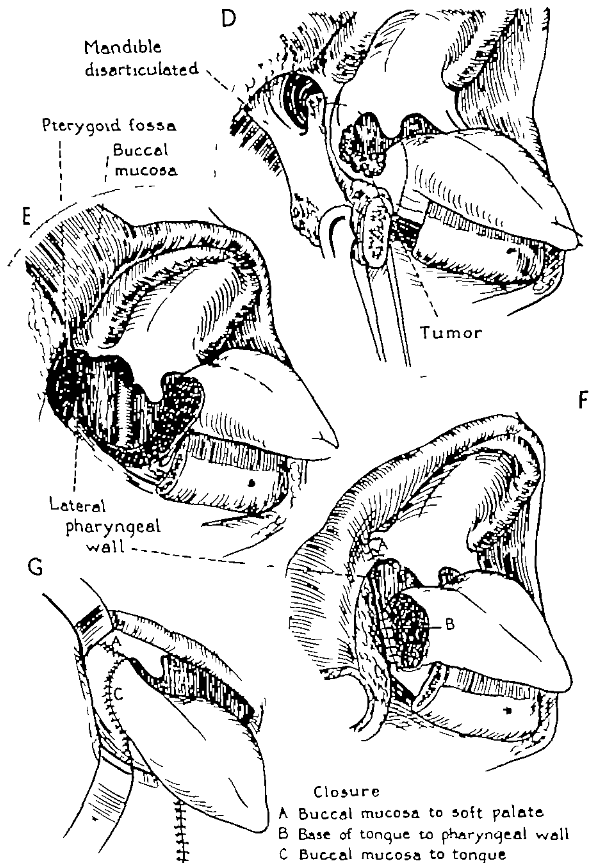
D—Lesions of the tonsil or more extensive base of tongue lesions with pharyngeal wall involvement require resection of the ascending ramus of the mandible The mandible is divided anterior to its angle and freed above by severing the temporalis muscle at its insertion on the coronoid process and freeing the condyle or dividing the neck of the mandible just beneath the condyle The tongue is pulled forward and the mandibular fragment rotated outward to expose the tumor An incision is commenced in the floor of the mouth at the point of division of the mandible and carried completely around the tumor

E—It is frequently necessary to include portions of the base of the tongue, the pharyngeal wall, and the soft palate in the excision to secure an adequate margin of normal tissue about the lesion The pterygoid muscles are severed well away from their insertions on the inner aspect of the mandible and the bony fragment removed in continuity with the primary tumor Branches of the internal maxillary artery and veins of the pterygoid plexus are clamped and ligated The wound is then irrigated with saline

F—Primary closure of the operative defect requires considerable ingenuity on the part of the surgeon Every attempt should be made to get mucosal approximation without undue tension The suture line is started inferiorly, approximating the base of the tongue to the lateral pharyngeal wall with interrupted sutures of 2-0 chromic catgut Superiorly, the buccal mucosa and soft palate are approximated and the tongue swung laterally and upward to join this suture line On some occasions, a split-thickness skin graft must be inserted to close a portion of the defect Sutures holding the edges of the graft are tied over a gauze stent It is well to insert a naso-esophageal feeding tube before closure is completed, since the narrowed oropharynx will make this difficult in the postoperative period The mucosal suture line is reinforced by buried sutures of chromic catgut in the underlying muscle

G—Closure is completed anteriorly by approximating the mucosa in the gingivobuccal gutter with fine silk The lip is reconstructed and the cervical wound drained and closed in the usual manner A tracheostomy should be performed at the close of the operation not only because of the possibility of supraglottic edema but because of the temporary impairment of the swallowing reflex

PLATE 75


D
Mandible disarticulated
Pterygoid fossa
Buccal mucosa
E
Tumor
F
Lateral pharyngeal wall
G
A
C
B
Closure
A Buccal mucosa to soft palate
B Base of tongue to pharyngeal wall
C Buccal mucosa to tongue

CHAPTER 15

The Larynx, Hypopharynx, and Cervical Esophagus

ANATOMY

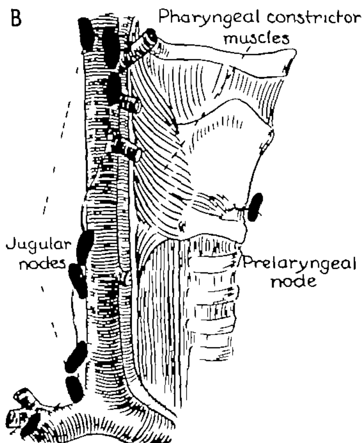
FOR CLINICAL PURPOSES, distinction is made between the *intrinsic* and the *extrinsic larynx* The intrinsic larynx consists of the true glottis, that space lying beneath the free margin of the false vocal cords and occupied by the true cords and the ventricles The extrinsic larynx lies above the glottis and includes the epiglottis, the arytenoid region, the aryepiglottic folds, and the false cords Certain hypopharyngeal structures lie in close proximity to the larynx These are the piriform sinuses, the glosso-epiglottic folds, and the vallecula We include these structures under the heading of extrinsic larynx not only for anatomic reasons but because neoplasms in these locations behave and are managed in a manner similar to those of the extrinsic larynx The cervical esophagus begins at the lower border of the cricoid cartilage and extends downward to the thoracic inlet behind the trachea

Lymphatics from the larynx drain into the upper and middle groups of nodes in the deep jugular chain There is also a prelaryngeal node lying anterior to the cricothyroid membrane which is occasionally involved in disease of the intrinsic larynx The cervical esophagus is drained by middle and lower deep jugular nodes and occasionally by nodes in the accessory chain

PLATE 76

A

Ventricle
Epiglottis
Vallecula
Extrinsic larynx
Intrinsic larynx
Thyroid cartilage
True cord
False cord
Aryepiglottic fold
Arytenoid cartilage
Piriform sinus
Esophagus
Trachea



FOREIGN BODIES

A great variety of foreign bodies may become impacted in the upper respiratory or upper gastrointestinal tract The more commonly seen objects include safety pins, coins, bones of fish or fowl, portions of artificial dentures, and fragments of ingested food The common points of impaction are the palatine and lingual tonsils, the piriform sinuses, the intrinsic larynx, and the cervical esophagus just below the cricopharyngeus muscle

In adults, the diagnosis is usually made readily, given a history of the foreign body and the complaint of "something sticking in the throat" As emphasized by Chevalier Jackson, however, a symptomless interval of hours or days may occur between the initial episode of choking and coughing and later symptoms caused by the foreign body In infants and small children without a history of foreign body ingestion, the diagnosis must be suspected in the presence of gagging, hoarseness, stridor, or dysphagia Roentgenograms of the head and neck, the chest, and the abdomen are often of invaluable aid in evaluating the nature and position of the foreign body and in ruling out multiple objects

Treatment On occasion, an emergency tracheostomy is indicated for acute obstructive symptoms due to a foreign body in the larynx If the airway is not obstructed, however, the situation should not be dealt with as a dire emergency Careful preparation and planning for the method of disimpaction and extraction of the object will contribute toward a successful result and help avoid complications Various types of grasping forceps should be tested on a duplicate of the foreign body in the position in which it is thought to lie In complicated situations, the help of an expert endoscopist should be sought

Foreign bodies embedded in the tonsil or pharyngeal wall may be grasped under direct vision Objects in the hypopharynx or larynx must be located and removed through the direct laryngoscope Topical anesthesia is used for adults, no anesthetic is given infants and small children Endoscopy is performed with the patient tilted in a head-down position so that if the object is dislodged it will not fall into the bronchi on inspiration Objects should be extracted with their long axis in the sagittal plane

Foreign bodies in the cervical esophagus are usually lodged just at the thoracic inlet below the cricopharyngeus muscle They should be visualized and extracted through the esophagoscope The object must be approached cautiously Protruding points or jagged edges are visualized and extraction carried out in a manner that will prevent perforation or laceration of the esophagus Sharp points may be grasped and sheathed by the lip of the esophagoscope On occasion rotation of the foreign body is possible so that it may be removed with the pointed extremity trailing The object is turned into the frontal plane to pass the narrowing posterior to the cricoid cartilage

Direct operative exposure is seldom indicated for the removal of foreign bodies in the upper air or food passages Almost all such objects can be removed endoscopically by the trained operator with adequate equipment

PERFORATION OF THE PHARYNX OR ESOPHAGUS

At times during difficult endoscopic procedures with or without foreign body removal the operator may note a laceration of the mucosa caused by the instrument or a foreign body and repair should be undertaken without delay We are opposed to the policy of instituting antibiotic therapy and merely observing the patient, since there is serious risk of deep cervical infection and mediastinitis The hypopharynx and esophagus are widely exposed by a lateral pharyngotomy (see Plate 77) The laceration is identified and closed with several layers of fine chromic catgut through the mucosa and the muscle A drain is always inserted near the point of repair before wound closure

If a perforation is unsuspected, its first evidence may be the patient's complaint of dysphagia and pain or fullness in the neck. This is rapidly followed by fever leukocytosis subcutaneous crepitus and by signs of mediastinitis Immediate drainage through a lateral pharyngotomy is indicated The perforation often cannot be closed successfully and free drainage only can be accomplished The patient is maintained on tube feedings or parenteral fluids spontaneous closure usually occurs within 1 or 2 weeks

CANCER OF THE LARYNX AND CERVICAL ESOPHAGUS

Once the histologic diagnosis of cancer of the larynx has been obtained by direct laryngoscopy and biopsy, several treatment methods are available It should be emphasized that no single form of therapy is applicable to all forms of laryngeal cancer Use of one surgical procedure for all tumors in this region or universal recommendation of radiotherapy indicates a failure of the physician to appreciate behavior of the various laryngeal tumors and their response to treatment

Intrinsic larynx—Cancers confined to the intrinsic larynx are generally of a low grade of malignancy and tend to remain localized for long periods Regional lymph node metastases occur late in the course of the disease Superficial tumors of the vocal cords may be treated with high-voltage x-ray therapy with preservation of the voice and an excellent possibility for permanent control of the disease A superficial cancer confined to one vocal cord may also be treated by partial removal of the larynx with an equal chance of successful control and a fair to good resultant voice

We do not consider more advanced cancers of the intrinsic larynx with fixation of the vocal cord or invasion of cartilage to be good candidates for either radiotherapy or partial laryngectomy The chance of curing these lesions by external irradiation falls to 50% or less The frequently heard argument that if radiotherapy fails, these patients can still be salvaged by surgery is not entirely sound It is a known principle of cancer therapy that the first attack on the disease should be the one offering the best hope of cure, since any subsequent efforts offer ever-diminishing chances of salvage Radiotherapy administered to a more advanced cancer of the larynx is often followed by persistent laryngeal edema, necessitating tracheostomy Frequent biopsies and long periods of observation are often necessary to establish a diagnosis of persistent cancer and by the time the diagnosis is made, the disease may have progressed to a stage which is difficult or impossible to eradicate Such cancers of the intrinsic larynx should be treated primarily by total laryngectomy A neck dissection is performed with the laryngectomy if clinically involved cervical nodes are present

Extrinsic larynx.—Malignant tumors of the extrinsic larynx are more anaplastic and are more aggressive in their behavior. They are locally invasive lesions which metastasize early in their course to the cervical lymph nodes. There is a paucity of early symptoms. The patient is seldom warned by hoarseness; there may be only slight dysphagia. Often, the first evidence of a tumor in this region may be the appearance of a lump in the neck.

We believe cancer of the extrinsic larynx and hypopharynx to be almost entirely a surgical problem. Many of these tumors were formerly considered "inoperable" and were treated by external irradiation. The over-all results of radiotherapy have been poor and we have been discouraged with radiotherapy even when given for palliation of these tumors. Results in recent years have been far more encouraging with the use of a wide-field laryngopharyngectomy combined with radical neck dissection. Cervical lymph node metastases and direct extensions of these tumors into the neck are so common that a neck dissection is performed at the time of excision of the primary lesion even without palpable evidence of metastatic disease. Resection of the mucosa of the entire circumference of the hypopharynx is seldom necessary and we have obtained primary closure following laryngopharyngectomy without resort to staged operations or plastic procedures.

Cervical esophagus.—The usual cancer of the cervical esophagus requires laryngectomy and often a radical neck dissection as well as resection of the primary tumor. Re-establishment of the continuity of the upper food passages has been one of the great problems in this field. One must choose between the staged procedures recommended by Wookey* and the use of a skin graft lined stent of tantalum mesh described by Edgerton.† Because of the complications of necrosis, fistula, and late stricture following the latter procedure, we prefer the Wookey type operation despite the stages required and the difficulties in nursing care. It is emphasized that this procedure is used only when the entire circumference of the esophagus is removed.

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*Wookey, H. Surgical treatment of carcinoma of the hypopharynx and esophagus. Brit. J. Surg. 35: 249, 1948.

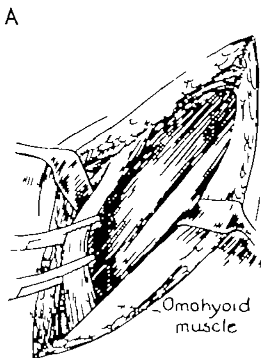
†Edgerton, M. T. One stage reconstruction of the cervical esophagus or trachea. Surgery 31: 239, 1952.

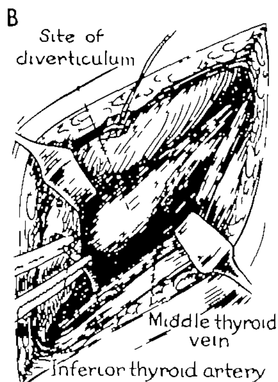
CANCER OF THE LARYNX AND CERVICAL ESOPHAGUS

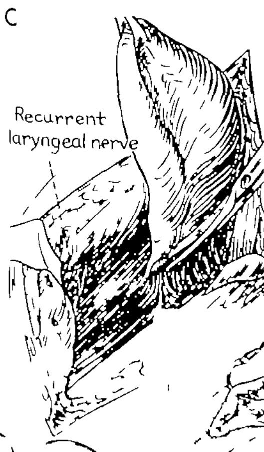
Once the histologic diagnosis of cancer of the larynx has been obtained by direct laryngoscopy and biopsy, several treatment methods are available It should be emphasized that no single form of therapy is applicable to all forms of laryngeal cancer Use of one surgical procedure for all tumors in this region or universal recommendation of radiotherapy indicates a failure of the physician to appreciate behavior of the various laryngeal tumors and their response to treatment

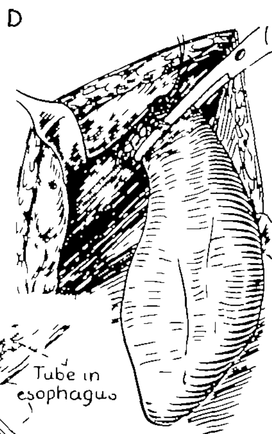
Intrinsic larynx—Cancers confined to the intrinsic larynx are generally of a low grade of malignancy and tend to remain localized for long periods Regional lymph node metastases occur late in the course of the disease Superficial tumors of the vocal cords may be treated with high-voltage x-ray therapy with preservation of the voice and an excellent possibility for permanent control of the disease A superficial cancer confined to one vocal cord may also be treated by partial removal of the larynx with an equal chance of successful control and a fair to good resultant voice

We do not consider more advanced cancers of the intrinsic larynx with fixation of the vocal cord or invasion of cartilage to be good candidates for either radiotherapy or partial laryngectomy The chance of curing these lesions by external irradiation falls to 50% or less The frequently heard argument that if radiotherapy fails, these patients can still be salvaged by surgery is not entirely sound It is a known principle of cancer therapy that the first attack on the disease should be the one offering the best hope of cure, since any subsequent efforts offer ever-diminishing chances of salvage Radiotherapy administered to a more advanced cancer of the larynx is often followed by persistent laryngeal edema, necessitating tracheostomy Frequent biopsies and long periods of observation are often necessary to establish a diagnosis of persistent cancer and by the time the diagnosis is made, the disease may have progressed to a stage which is difficult or impossible to eradicate Such cancers of the intrinsic larynx should be treated primarily by total laryngectomy A neck dissection is performed with the laryngectomy if clinically involved cervical nodes are present


A
Omohyoid
muscle


B
Site of
diverticulum
Middle thyroid
vein
Inferior thyroid artery


C
Recurrent
laryngeal nerve
Tube in
esophagus


D

Pulsion-type diverticula arise from the posterior or posterolateral aspect of the hypopharynx The commonest site of origin is near the midline between the cricopharyngeus and the remainder of the inferior pharyngeal constrictor above The diverticula extend downward in the plane between the prevertebral and pretracheal fascial layers and most often deviate to the left The patient usually gives a prolonged history of dysphagia, regurgitation, and of a mass which appears while swallowing

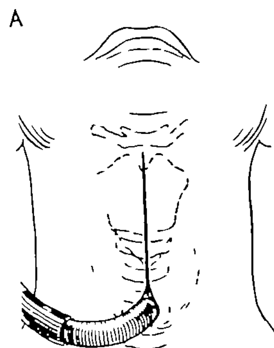
A —Endotracheal anesthesia is used An incision is made along the anterior border of the left sternocleidomastoid muscle from its mid-portion downward to just above the sternoclavicular joint The incision is carried through the superficial layer of the deep cervical fascia The sternocleidomastoid and underlying carotid sheath are retracted laterally The anterior belly of the omohyoid is seen crossing the field obliquely and is divided and retracted

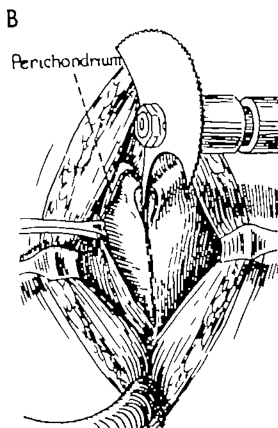
B —The thyroid gland is retracted medially It is usually necessary to divide the middle thyroid vein for adequate exposure The inferior thyroid artery crosses over the diverticulum and is divided between ligatures The diverticulum is identified and freed from surrounding structures Large diverticula must be elevated from the superior mediastinum by traction and finger dissection

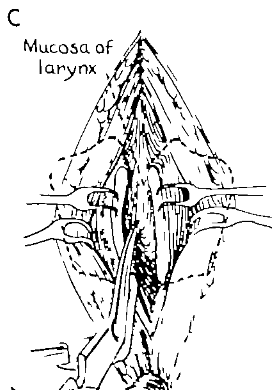
C —The diverticulum is elevated and completely freed to its point of origin on the posterior pharyngeal wall The sparse covering of longitudinal muscle fibers is dissected away from the diverticulum at its neck, exposing the submucosa It is generally necessary to expose the recurrent laryngeal nerve and trace it upward to its entrance into the larynx to prevent nerve injury

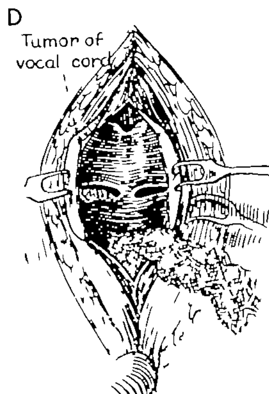
D —The neck of the diverticulum is closed with numerous interrupted sutures of fine silk, severing and closing a portion of the neck of the sac at one time A second layer of silk sutures is placed in the muscle It is important to avoid undue traction on the diverticulum during closure to prevent encroachment of the suture line on the esophageal lumen A tube passed through the esophagus from above aids in identifying its lumen and avoiding constriction A small Penrose drain is inserted in the wound, and the omohyoid, the deep fascia, platysma, and skin edges are approximated separately The patient is maintained on nasal tube feedings for 5 days following surgery

PLATE 78









This procedure is ideally applicable to superficial neoplasms confined to one vocal cord. Its indications have at times been widened to include tumors extending up into the ventricle, on the anterior commissure, or a short distance below the cord. Such cases must be carefully selected, however, for the operation is not a radical procedure and is suitable only for early, localized tumors.

A.—A tracheostomy is performed under local anesthesia. An endotracheal tube is inserted in the trachea and a general anesthetic is administered. The vertical incision is continued upward in the midline to a point midway between the hyoid bone and the thyroid cartilage. The sternothyroid muscles are separated in the midline and retracted to expose the thyroid cartilage.

B.—A vertical midline incision is made directly on the thyroid cartilage. A small periosteal elevator is used to reflect the perichondrium away from the cartilage on the side of the tumor. The thyroid cartilage is then divided longitudinally in the midline with a power saw (Stryker).

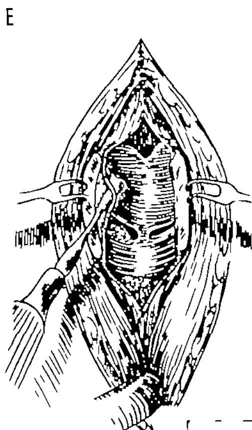
C.—Small hook retractors are then used to gently separate the divided cartilage. An incision is made through the cricothyroid membrane and blunt-nosed scissors introduced upward between the vocal cords. The scissors divide the mucosa of the anterior wall of the glottis in the midline.

D.—Further retraction of the divided cartilage will expose the interior of the larynx. A small pack of moist gauze is placed distally in the trachea above the endotracheal airway to prevent aspiration of blood or mucus. An additional pledget of gauze moistened with a 10% cocaine solution is placed in the larynx for several minutes; this obviates the necessity for extremely deep general anesthesia to prevent spasm of the laryngeal muscles. The extent of the tumor of the intrinsic larynx is then determined.

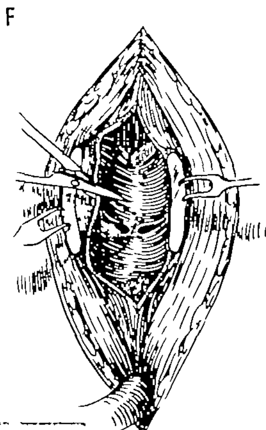
[Partial laryngectomy *continued on page 286*.]

PLATE 78

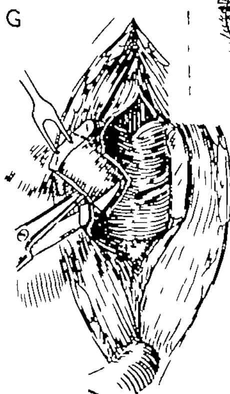
E



F

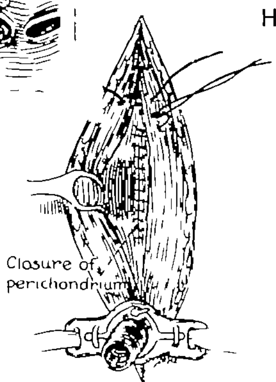


G





H



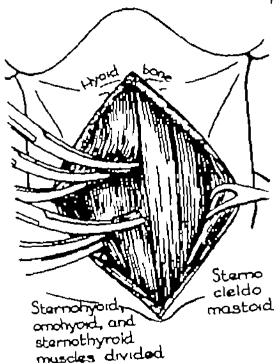
E.—The mucosa on the involved side of the larynx is reflected away from the entire inner aspect of the thyroid cartilage with a small periosteal elevator. The mucosa of the ventricle and the false cord are elevated, as well as mucosa in the subglottic region.

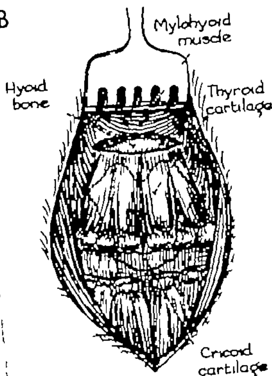
F.—With the tumor under direct visualization, the involved vocal cord is then excised with an adequate margin of normal mucous membrane. If indicated, the excision may include the ventricle and part or all of the false vocal cord.

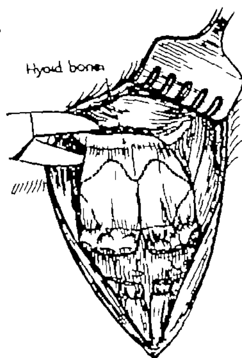
G.—In most instances, a subtotal removal of the thyroid cartilage on the involved side is performed. This not only allows a wider excision of tissue but allows the perichondrium to fall toward the midline so that the remaining vocal cord may approach it for phonation. If the lesion was very small and superficial, requiring only excision of the vocal cord, the mucous membrane above and below the cord is approximated with a continuous suture of fine chromic catgut and the cartilage is left in situ (inset). Complete hemostasis is obtained with ties and sutures of fine chromic catgut and the pack is removed from the trachea.

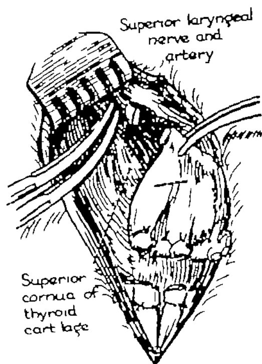
H.—The perichondrium is approximated with interrupted sutures of 2-0 chromic catgut. The strap muscles are approximated in the midline and the platysma and skin are closed separately. A tracheostomy tube is left in place for 24-48 hours and removed when the surgeon is sure the airway is adequate.

PLATE 79


A
Hyoid bone
Sterno cleido mastoid
Sternohyoid, omohyoid, and sternothyroid muscles divided


B
Mylohyoid muscle
Hyoid bone
Thyroid cartilage
Cricoid cartilage


C
Hyoid bone


D
Superior laryngeal nerve and artery
Superior cornua of thyroid cart lage

Total laryngectomy as described in some texts consists of a skeletonization of the larynx by dissection immediately on the cartilages, and removal of the organ with few surrounding tissues The following block dissection performed by us entails removal of the larynx with the strap muscles and the central portion of the hyoid bone attached The pre-epiglottic space, an occasional site of spread from laryngeal cancer, is not entered in this procedure, but is removed intact with the operative specimen

A —The patient is placed in the supine position with the head extended An endotracheal tube for anesthesia should be inserted, if possible, occasionally, a bulky laryngeal tumor will prevent this and a tracheostomy must be performed at the start of the procedure for control of the airway A midline incision is made from the suprasternal notch to just above the hyoid bone Skin flaps, including the platysma, are raised as far laterally as the sternocleidomastoid muscle on each side The sternothyroid, sternohyoid, and omohyoid muscles on each side are then divided between clamps at about the level of the cricoid cartilage

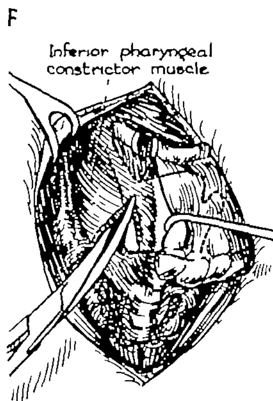
B —The middle one third of the hyoid bone is exposed by a transverse incision directly on it The suprahyoid muscles are severed from this portion of the bone by sharp dissection

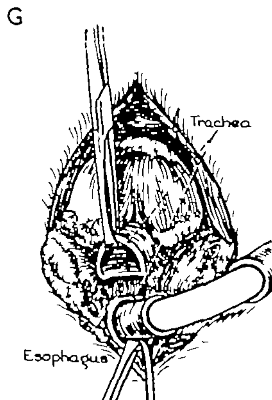
C —The hyoid bone is divided at the junction of its middle and lateral thirds with a bone-cutting forceps, so that the middle third with inserting strap muscles remains attached to the larynx The fascia between the upper portion of the omohyoid and the sternocleidomastoid muscles is incised

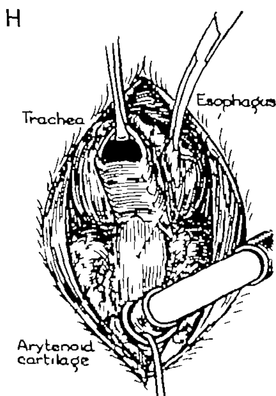
D —Lateral retraction of the isolated portion of the hyoid bone will then aid in exposure of the superior laryngeal nerve and vessels coursing medially and downward just above the superior cornua of the thyroid cartilage The nerves and vessels are divided and ligated on each side

[Total laryngectomy *continued on page 290*]


E
Superior thyroid vessels
Cricothyroid muscle
Thyroid isthmus


F
Inferior pharyngeal constrictor muscle


G
Trachea
Esophagus


H
Trachea
Esophagus
Arytenoid cartilage

E—The isthmus of the thyroid gland is divided between clamps, and each portion of the thyroid dissected away from the trachea The superior pole of the thyroid is retracted laterally and the superior thyroid vessels are freed from their proximity to the larynx by sharp dissection

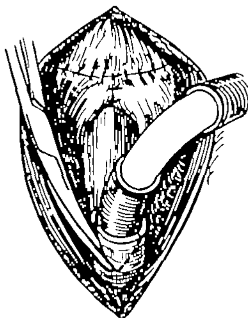
F—The larynx is rotated so as to expose the posterior edge of the thyroid cartilage on one side and then the other The inferior pharyngeal constrictor muscle is severed from its attachment to the thyroid cartilage on each side

G—The endotracheal tube is removed by the anesthesiologist, and the trachea completely divided by an incision just below the cricoid cartilage If there is known or suspected subglottic extension of the cancer, the trachea may be divided at a lower point A balloon-cuffed tube for anesthesia is inserted in the distal trachea and the balloon inflated

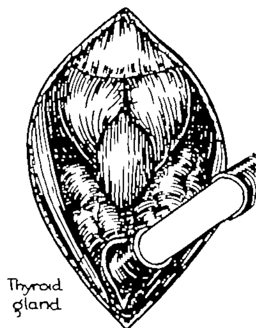
H—The larynx is then elevated and freed from the cervical esophagus from below upward to the level of the arytenoid cartilages In the midline, the larynx may be easily freed from the esophagus by blunt dissection Laterally, the attachments must be severed with dissecting scissors

[Total laryngectomy *continued on page 292*]

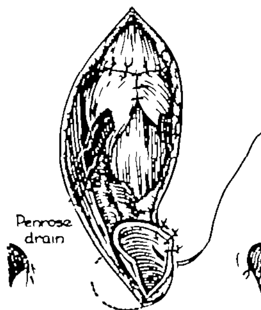
M



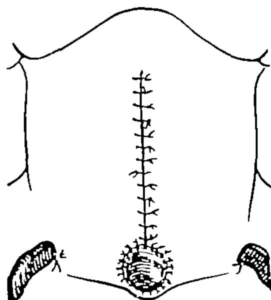
N



O



P



M—The trachea is cut in an oblique anteroposterior fashion so as to increase the diameter of the tracheal stoma This is accomplished by making a vertical anterior incision downward across several tracheal rings Heavy scissors are then used to excise triangular fragments of the anterior tracheal wall from the lowest *point of this incision upward toward the membranous portion of* the trachea

N—The dead space posterior to the upper portion of the trachea may be obliterated by approximating the two portions of the thyroid behind the trachea with several interrupted sutures

O—Small Penrose drains are inserted through stab wounds on each side of the neck and are placed just below the pharyngeal *suture line A small half circle of skin is excised from each* side of the lower skin flaps and the trachea approximated to the skin edges with numerous sutures of fine silk carried completely through the tracheal wall

P—The remainder of the wound is closed by separate approximation of the platysma and skin edges A no 12 laryngectomy tube is inserted in the tracheal stoma and a pressure dressing applied to the neck The patient is allowed to commence swallowing liquids on the 7th postoperative day Sutures are allowed to remain in the trachea for 10 days

A

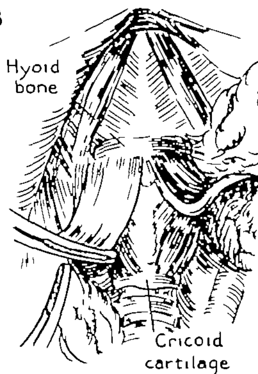
Left neck contents

Superior laryngeal artery

Thyroid gland-
left portion
right portion

Superior thyroid artery

Inferior thyroid artery





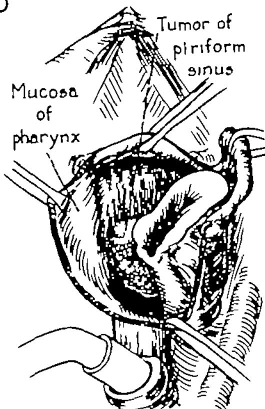
This combined operation is performed for cancer of the extrinsic larynx or hypopharynx It is also indicated for advanced lesions of the intrinsic larynx that have extended beyond its boundaries or metastasized to cervical lymph nodes The procedure shown is a laryngopharyngectomy combined with a left radical neck dissection for a typical carcinoma of the left piriform sinus

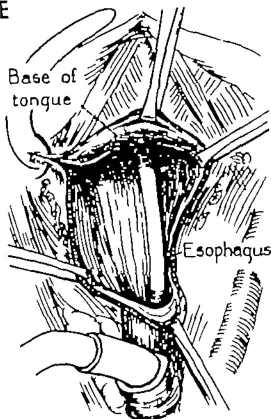
A —Endotracheal anesthesia is used If intubation cannot be performed because of a bulky laryngeal tumor, a preliminary tracheostomy is necessary The incision is the same as that used for a radical neck dissection (Chapter 14) The anterior flap of skin and platysma is elevated until the border of the sternocleidomastoid muscle on the opposite side of the neck is visualized The radical neck dissection is carried out in the usual manner with the following additions The sternohyoid and sternothyroid muscles on the left are divided at the same level as the sternocleidomastoid and reflected upward with that muscle and the omohyoid The thyroid gland thus exposed is divided at its isthmus and the left lobe reflected upward in the neck with the muscles The left inferior thyroid artery and vein, as well as the middle thyroid vein, are divided The superior thyroid artery is divided and ligated at its origin from the external carotid No attempt is made to identify the left recurrent laryngeal nerve or parathyroid tissue

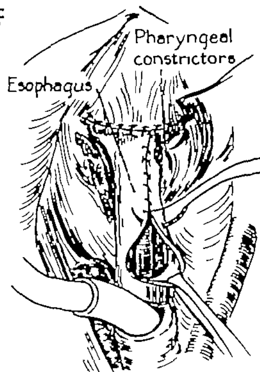
B —The neck dissection is completed, leaving the left thyroid lobe, the strap muscles, and the neck contents attached to the left side of the larynx The strap muscles on the right are divided and secured at the level of the cricoid cartilage The right portion of the thyroid is reflected away from the trachea

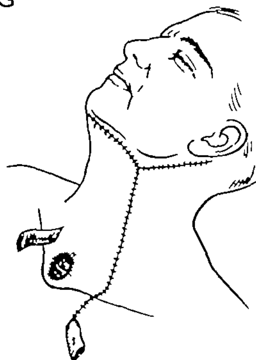
C —The middle third of the hyoid bone is isolated as in a total laryngectomy The superior laryngeal nerve and vessels are divided on the right The trachea is divided between its first and second rings and a balloon-cuffed tube is inserted in the distal trachea for continued anesthesia The larynx is rotated to the left and the inferior pharyngeal constrictor muscle is severed along its point of attachment to the right thyroid cartilage The pharyngeal wall is opened on the right at a point farthest removed from the tumor

[Total laryngectomy and radical neck dissection *continued on page 298*]


D
Tumor of piriform sinus
Mucosa of pharynx


E
Base of tongue
Esophagus


F
Pharyngeal constrictors
Esophagus


G

D—The opening into the right side of the pharynx is enlarged by incising the mucous membrane along its attachment to the thyroid cartilage and the right side of the epiglottis The full extent of the tumor in the left piriform sinus is then visualized The pharyngeal mucosa is then incised around the lesion, securing a margin of at least 2 cm of normal-appearing mucosa on all sides The tissue excised varies with the size and location of the tumor Involvement of the base of the epiglottis will require excision of a considerable portion of the base of the tongue Piriform sinus lesions require resection of the lateral pharyngeal wall beyond the tumor, the superior limit of such an excision often will extend to or include the palatine tonsil

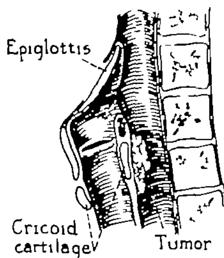
E—Following incision of the pharyngeal mucosa and the underlying pharyngeal constrictor muscle, the operative specimen is removed It contains the tumor with larynx and neck contents attached A considerable defect of anterior and lateral pharyngeal wall will remain between the base of the tongue above and the esophagus below It is almost always possible to effect primary closure without resorting to plastic reconstructive procedures Closure is started at an upper outer corner of the defect The mucosa of the lateral pharyngeal wall is approximated to the base of the tongue with a Connell suture of 3-0 chromic catgut

F—A similar suture is commenced at the opposite upper angle of the wound, the two sutures meet near the midline Slight flexion of the head will aid in reducing tension The anterior cut edge of the esophagus often will not meet the base of the tongue, and closure is completed in a Y-shaped suture line as shown here A naso-esophageal feeding catheter is passed before completion of the closure The suture line is reinforced as much as is possible by numerous interrupted sutures of 3-0 chromic catgut between the base of the tongue, remnants of pharyngeal constrictors, and any other tissue locally available

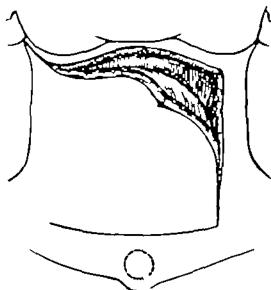
G—A 3-cm circle of skin is excised above the sternal notch and a tracheal stoma constructed with numerous interrupted fine silk sutures as in total laryngectomy The operative wound is drained and closed in the usual manner

PLATE 81

A



B



C

Pharynx
Epiglottis
Hyoid bone divided
Left portion of thyroid gland
Esophagus

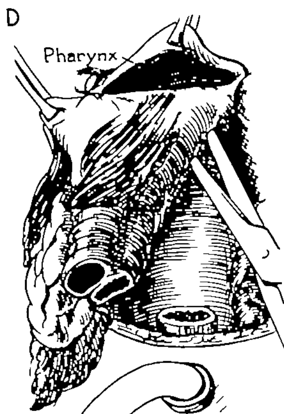
Cervical Esophagectomy

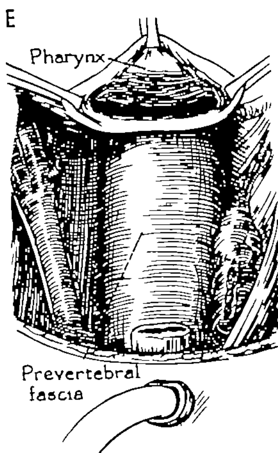
A—This procedure is performed for a carcinoma of the postcricoid region with metastasis to lymph nodes in the right jugular chain The larynx must be sacrificed in most cancers of the cervical esophagus The plastic repair recommended by Wookey (shown here) is applicable following resection of many of these tumors When the lesion involves the esophagus at the thoracic inlet, however, some other method of reconstruction must be adopted The stomach or the right colon must be brought up into the neck through the thorax to re-establish the continuity of the food passages On the rare occasions in which the larynx can be preserved, a temporary tracheostomy is necessary in the immediate postoperative period

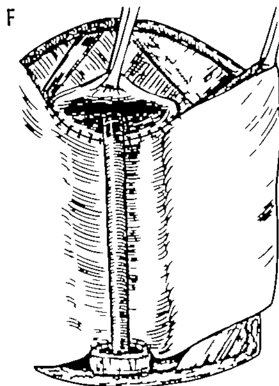
B—A large rectangular flap of skin and platysma, based on the right, is outlined and elevated by sharp dissection During the operative procedure, this flap is protected with moist pads In some patients, particularly those who have been irradiated, the flap is based on the opposite side of the neck and not elevated beyond the sternocleidomastoid

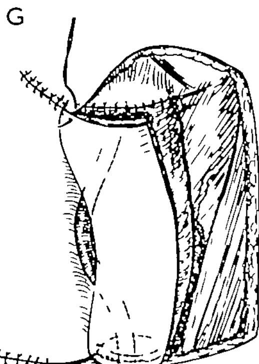
C—A right radical neck dissection is performed in a manner similar to that described for neck dissection with total laryngectomy The neck contents remain attached to the larynx The prethyroid muscles are divided below the level of the cricoid cartilage The thyroid gland is divided at its isthmus and each portion reflected away from the trachea The right portion is removed with the operative specimen The left side of the larynx is mobilized by incising the fascia lateral to the strap muscles The middle third of the hyoid bone is isolated as in total laryngectomy, and the superior laryngeal vessels and nerves are divided and secured on each side The trachea is divided at a point safely away from the esophageal lesion and a balloon-cuffed tube inserted in the distal trachea for continuation of anesthesia The pharynx is opened by a transverse incision above the hyoid bone and above the tip of the epiglottis The epiglottis is pulled forward and the tumor visualized

[Cervical esophagectomy *continued on page* 302]


D
Pharynx


E
Pharynx
Prevertebral
fascia


F


G

D—With the postcricoid cancer constantly visualized, the pharyngeal mucosa is incised circumferentially at a safe distance above the lesion Suction is applied to the pharynx to prevent undue contamination of the operative wound with saliva The cervical esophagus is then transected well below the tumor The proximal esophagus is elevated and dissection carried upward in the plane between the esophagus and the prevertebral fascia The segment of esophagus is removed with the larynx, right portion of thyroid, and right neck contents attached A circle of skin 2.5 cm in diameter is excised below the lower edge of the wound and the distal trachea drawn through this opening It is desirable to have as wide a bridge of skin as possible between the tracheal stoma and the esophagus

E—Complete hemostasis is secured and the wound is thoroughly irrigated with saline The continuity of the upper gastrointestinal tract must now be re-established It is impossible to approximate the cut end of the esophagus directly to the hypopharynx The gap must be bridged by the skin flap, and closure obtained in stages as described below

F—The rectangular skin flap is drawn across the operative defect Its undersurface is tacked to the prevertebral fascia with a number of interrupted sutures of fine chromic catgut The posterior wall of the pharynx is approximated to the upper edge of the skin flap with interrupted sutures of fine silk The posterior wall of the end of the esophagus is similarly attached to the skin flap at its lower edge A feeding catheter is passed from the nostril through the pharynx and into the distal end of the esophagus

G—The skin flap is then folded back on itself in an S-fashion, allowing completion of circumferential suture of the pharynx above and the esophagus below This forms an anterior, posterior, and left lateral wall of the new cervical esophagus On the right, there is a long open slit or sinus

[Cervical esophagectomy *continued on page 304*]

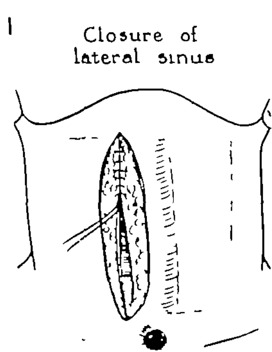
PLATE 81

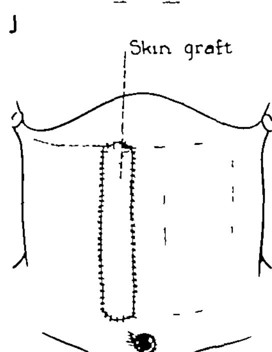
H

First stage completed

Lateral sinus

Graft



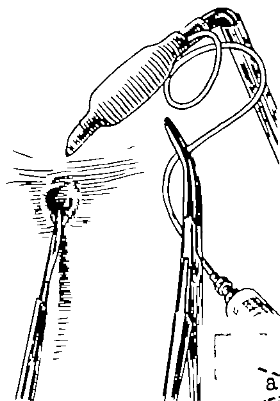


H—Any further closure of the wound that can be accomplished without tension on the skin flap is completed The remaining raw area to the left of the skin flap is covered with a split-thickness skin graft taken from the abdomen or thigh A tracheal stoma is formed by approximation of the end of the trachea to the skin with numerous fine silk sutures The right lateral fissure between the pharynx and esophagus remains to be closed at a second stage Drainage of saliva from this fissure in the interim is a constant troublesome problem

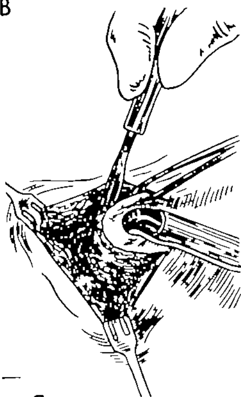
I—The final stage in reconstruction is performed 4-6 weeks after the first procedure, when wound healing is complete The skin is incised around the lateral fissure approximately 1 cm from its edges Small flaps of skin are undercut around the fissure until they may be approximated without tension If blood supply of these flaps does not seem adequate, they are replaced in their original site and final closure delayed for 3 more weeks

J—The skin flaps are approximated with interrupted sutures of 3-0 chromic catgut with the knots tied within the reconstructed food passage A small split-thickness graft is applied to the exposed raw surfaces The skin tube re-establishing esophageal continuity is now completely buried

A



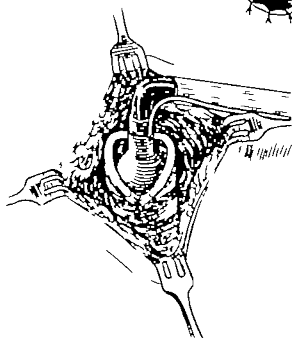
B

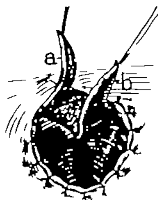


C



D





E



5] *Revision of Tracheal Stoma*

Following total laryngectomy, a ring of scar tissue may form around the tracheal stoma Stricture of the opening will occur with surprising rapidity if the patient fails to wear his tracheal cannula If stricture occurs, the stoma may be dilated gently with a forceps to admit a small-caliber tracheostomy tube A larger size tube is then inserted each day until an opening of the desired diameter has been obtained Stricture will recur unless the patient wears the tube for at least 12 hours each day Surgical revision of the stoma is indicated for those patients who are uncomfortable with continued use of the tube The ring of scar tissue is excised and a new wide tracheostome constructed The modification of the Z-plasty described below will break the circular ring of fibrous tissue and prevent further stenosis

A —The patient is given intravenous pentothal anesthesia, oxygen being administered via a catheter through the contracted stoma An incision is made across the scar tissue at the 6 o'clock position of the stoma to widen the opening and allow introduction of a balloon-cuffed endotracheal tube

B —With the balloon inflated to prevent aspiration of blood, an incision is made completely around the stoma about 0 5 cm from the mucocutaneous junction The trachea is mobilized for a distance of 4-5 cm by sharp and blunt dissection close to its wall This dissection usually must be carried downward into the mediastinum for adequate mobilization of the trachea

C —The area involved by the stricture at the proximal end of the trachea is excised The tracheal opening may be widened by removing a V-shaped portion of the anterior wall (see Total Laryngectomy)

D —A Z-plasty is performed by raising equal flaps from the skin above the stoma and from the membranous portion of the trachea

E —The flaps are transposed to break the circular ring at the mucocutaneous junction The skin and mucous membrane edges are approximated by numerous interrupted sutures of 4-0 silk A post-laryngectomy tube need not be worn after this procedure

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